# 80 U.S.

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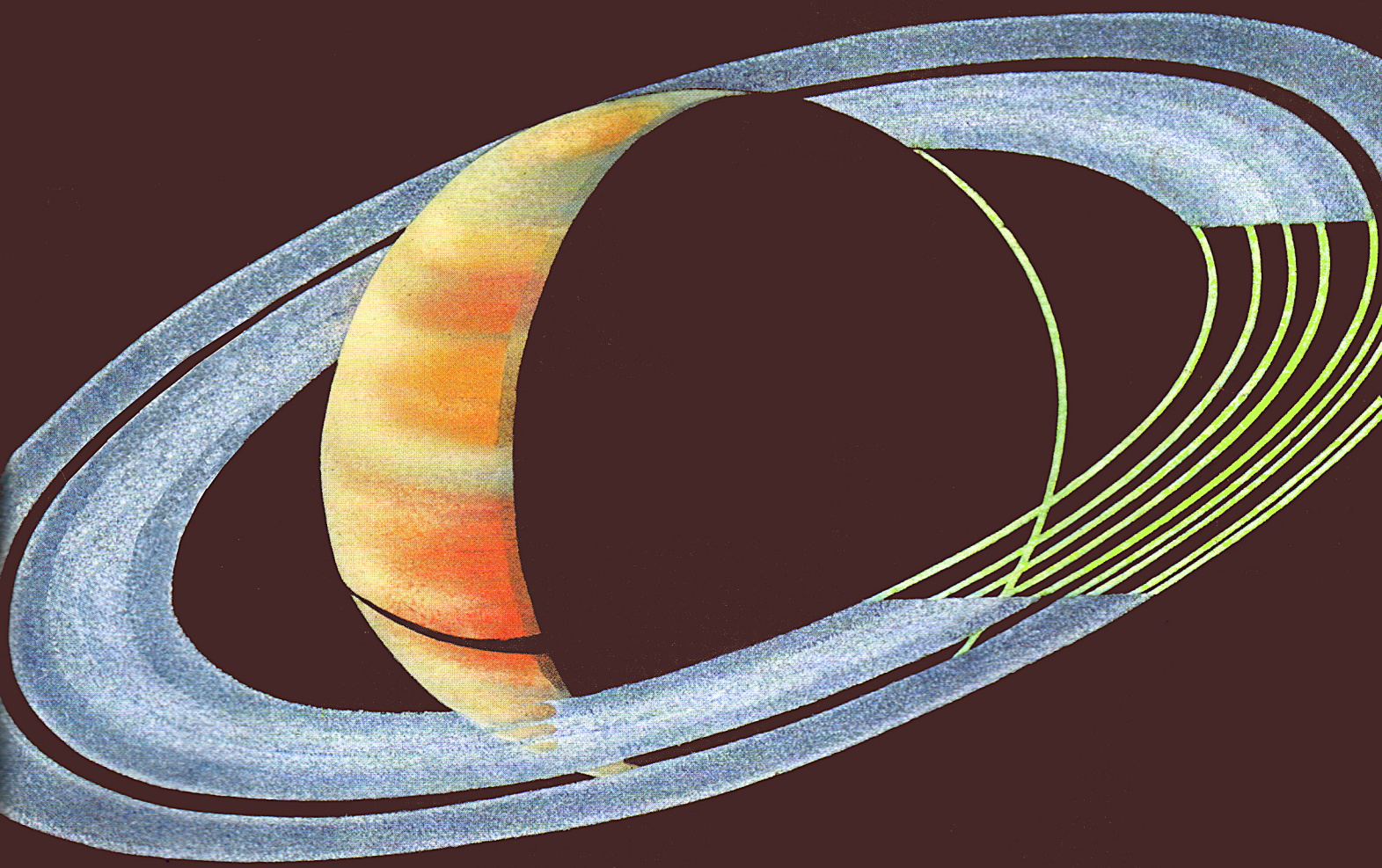

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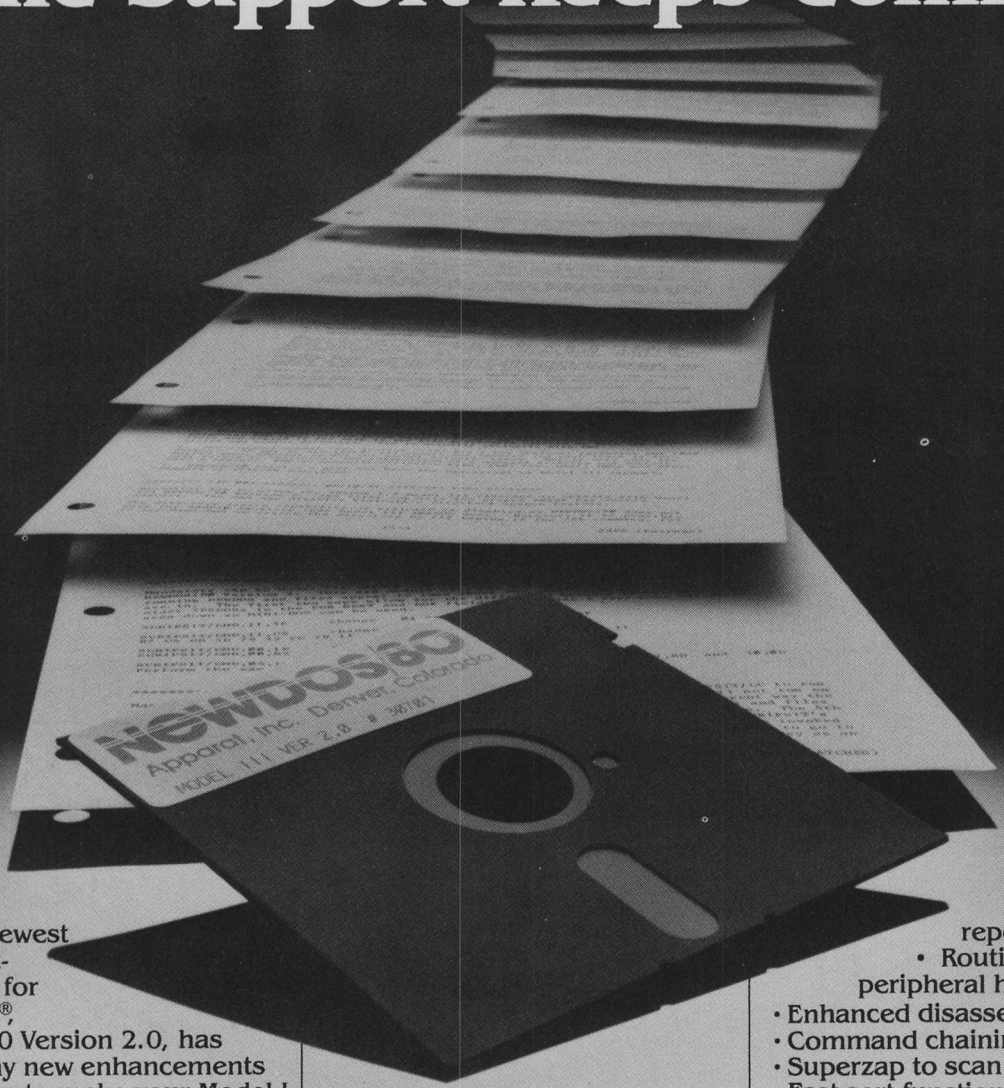


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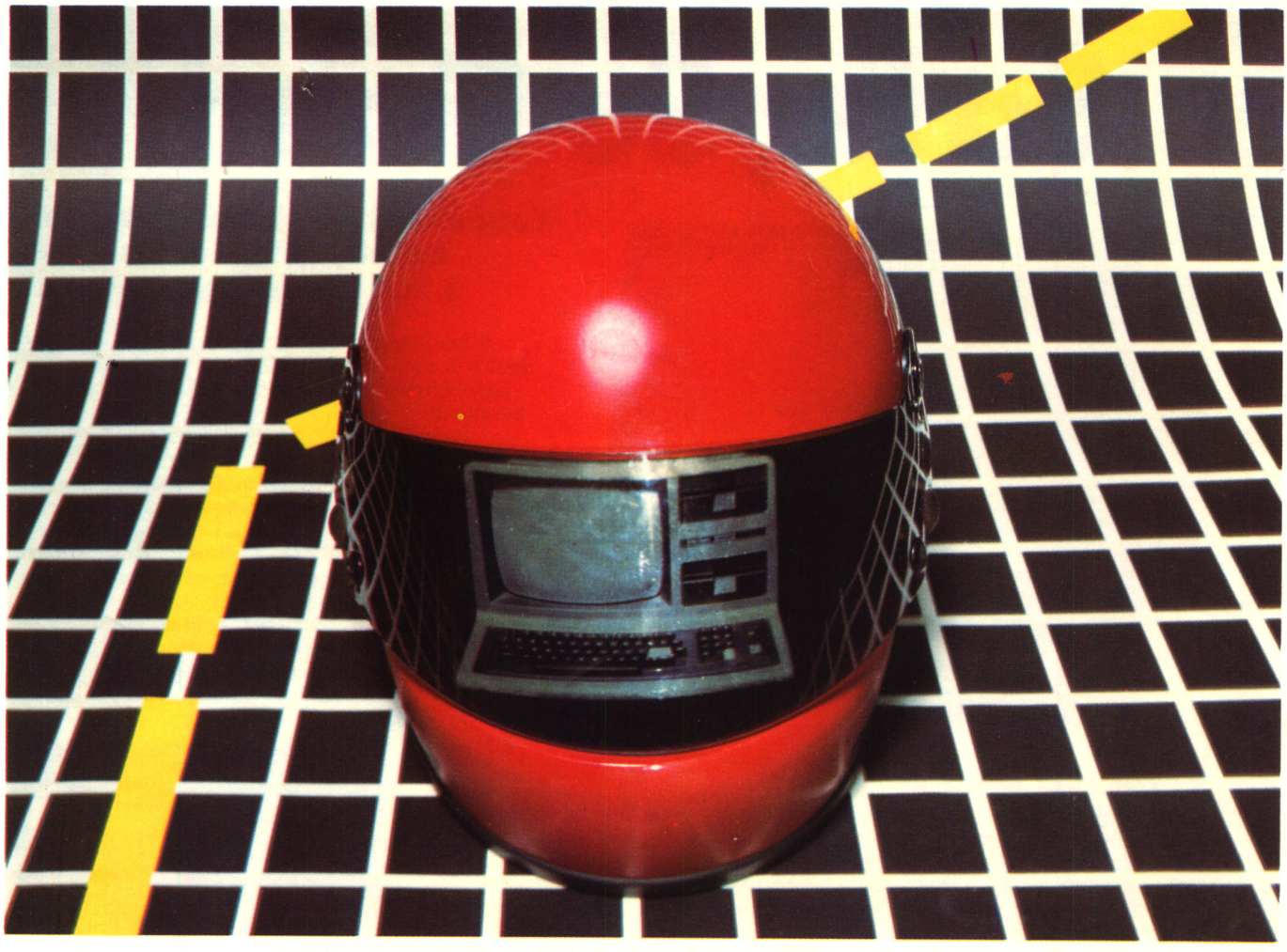

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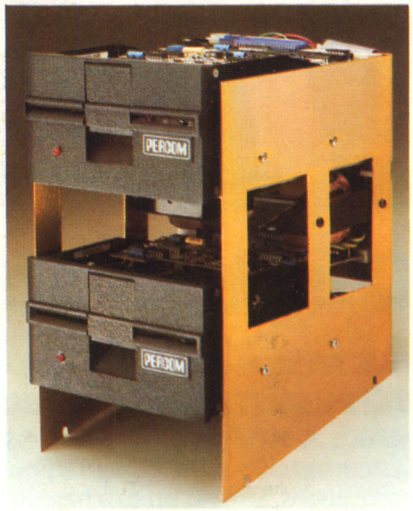


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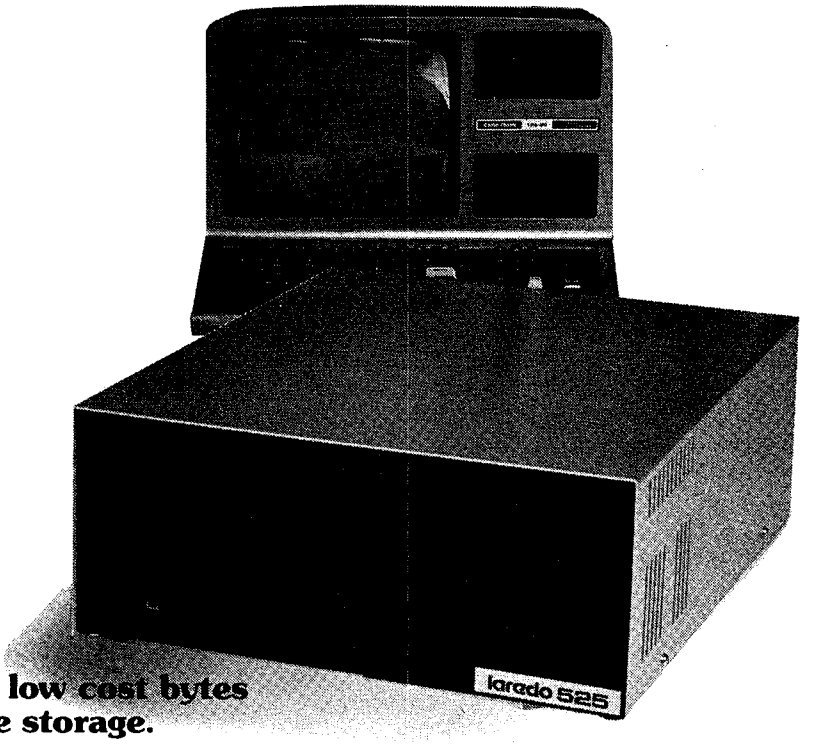


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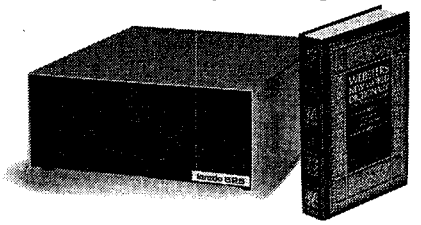

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**OUR COVER** for this "Space" issue features an original drawing by Thomas Scott Nelson of Upland, California. Our appreciation and that of the artist are extended to the Public Relations Department at Jet Propulsion Laboratories, Pasadena, California, for access to the wonderful images they supplied for research on the cover art. The lead story this month is about research at J.P.L. on page 16. A short program is provided on page 107 for a reproduction of our cover image.

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THE TRS-80 USERS JOURNAL

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# Editorial

Space: The final frontier — or is it the first real frontier? I remember being a patient in a veteran's hospital back in November, 1957, when the Russians put up their Sputnik. It was a big deal, no doubt about it. I had all the ear-marks of the beginning of something really big. It was, for a few years.

An ex-sergeant, who believed the earth was flat, said they were just putting one over on us. He said it was just another of those red-commie tricks and that they probably did it all with mirrors. Besides, he said, he had an amateur radio friend who couldn't pick up the signals, supposedly on or near the 20-meter ham band. It was enough to make a non-believer out of him.

The grand show came in 1969. The first man to set foot on the moon was an exciting spectacle. We all had the honor of watching it on television. It was a show to remember, and in our time zone it was conveniently staged on a Sunday afternoon.

The Russians always did their things first, then told about them later. Ours was very different. We watched the drama as it unfolded. Anything could go wrong and the whole world could witness it. (We either lucked out, or our mirrors worked better than theirs.) We got there and back, and then did it a few more times just to make sure that everyone knew that we could.

Everyone remembers the names of Armstrong, Aldrin and Collins. I always felt sorry for Mike Collins. He made it all the way to the moon and couldn't be one of the first to set foot upon it. He wrote a book about it later and called it "Carrying the Flame". In it, he hinted that it didn't bother him not to set down on the surface. It was the one part of his book I couldn't believe.

After the Apollo missions had come and gone, everyone expected to see more. It had been an excellent start, but somebody slammed the funding door in Washington and cut the whole manned program back. It's really too bad. According to one of the first three astronauts, it had cost each man, woman and child in the United States a little less than two dollars each to put those men on the moon.

Where else are you going to get that kind of entertainment for under two bucks apiece? Aside from the drama of it all, look at the advances in technology which came about from the space program. The microcomputer I used to write this editorial is just one example. There are a hundred more advances in electronics and medicine alone. We not only had a show, but are living better because of it. It's a shame the program was cut back.

I'm not a Bible-beater, but there is something to the phrase "beat your swords into plowshares". It's still good advice. There is nothing that would spur our "down" economy more than a joint manned space effort. Being involved in space exploration with your adversary could lead to better relations all around. Besides, we still have to convince the ex-sergeant that the earth is indeed shaped like an oblate spheroid.

**Mike**

# MAY SPECIALS

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After reading one (*of your issues*), I can see why Computerland never has any in stock! I got three useful (and well used) programs and a lot of good ideas out of the February 1982 issue. What I especially liked is the way your articles are written. I was even more pleased when the programs I typed in worked. That is more than I can say for a lot of other programs I have typed in. Keep up the good work!

**Carl Brown**
**Hershey, PA**

---

I am sure that you are constantly seeking ideas for future publication and in that vein I would like to offer my suggestions.

Two of the most widely used programs are VisiCalc and Scripsit. I find the documentation for Scripsit sadly lacking and inadequate. I would love to see a series of articles dedicated to the use of Scripsit on the Model I and III. An adjunct to this would be the use of Scripsit with some of the Superscript programs as used with some of the most popular printers (Epson 80, and 100 and others). This series of articles could fill a wide gap in the documentation.

VisiCalc is probably the most powerful program I have ever used. I have achieved some expertise with the program but am sure that there are tons of VC secrets out there. Some businessman (*must be*) using VC in an application not thought of by others. I would like to see articles on its use with sister programs that add to its usefulness. I can't afford to buy and try all these programs but on the recommendation of an article I certainly would purchase one or more if they filled my needs.

I would also like to see more programs or suggestions for uses of the micro for Attorneys. I recently started a project for an attorney and am finding many uses such as the printing of more than 50 form letters that many attorneys use.

**Richard Eidmann**
**Philadelphia, PA**

*Thank you for the suggestions. We use Scripsit a lot, VisiCalc just some of the time. We are in the process of putting together a "law" theme. The theme is supported, at present, by only two articles. It should appear a few months from now. —Ed.*

---

Please relay to Mr. Ralph G. White that I think his "Tic Tac Toe" program in your February 1982 issue is great! I learned more about string packing from copying his program than from any previous example I had ever seen. The game is fun to play too.

I deleted lines 1224 and 1274 as they seemed to serve no purpose. I added another B$ in the first print address of line 1560; that cleans the screen better. I modified the two endings to provide a "permanent" blinking statement of who won. I have to hit BREAK to play again.

Of the several computer magazines I read regularly, yours is the best for a TRS-80 owner. I copy most of your Fun 'N Games features and never fail to learn new programming techniques from them.

**William B. Oaks**
**Renton, WA**

---

...Please pass the following on to Bob Liddil as it concerns the *Book of BASIC Adventures*. I have two of the programs running on the Color Computer (which takes some doing since the 16K Color Computer with Extended BASIC has approximately 700 fewer bytes available for BASIC program storage than the 16K Model I with level II). The first program I attacked was Lost Dutchman's Gold. The problem concerns line 2060 which goes to a NEW command if the player does not want another game. The NEW command is ok when included in commercial software, but it can wipe out a program which was laboriously keyed in and debugged. If you haven't already, you may be getting some irate letters and a word of caution to book purchasers might be in order. Incidentally, although I haven't tried it, you could probably recover such a lost program by peeking through the program in the command mode to find the two end-of-program zeros and then poking the address of the next byte into memory locations 27 and 28 on the Color Computer and whatever the equivalent addresses are for other machines.

**Bob Roberts**
**Lancaster, OH**

*Your advice is certainly well taken. It can be frustrating to lose hours of work, but by now everyone must know the meaning of the NEW command and not put that line into the program until it is totally debugged and ready to save. — Ed.*

---

I got your January 1982 issue today — what a start for '82 — congratulations! I have never read a magazine with so much useful information.

I am a small businessman attempting to pay all the bills and employ the smallest number of staff, i.e., doing everything myself and going mad trying. I bought a computer two years ago and find it a great hobby — time permitting, maybe getting the computer to do the bookwork would give me more time to play with the computer! I do not think I am alone with this problem, and the 12-column ledger program *(in 80-U.S., Jan 82)* has given me great hope for the future. All I need now is the time to enter it (and convert to MX-80 codes). One point however, could you *please* print regularly how us readers can tell when our subscription is due? I dimly remember from an old issue it has to do with the number code on the label? or is your new addressing service sending reminders? I do not wish to miss a single (monthly!!) issue now.

**Will Teasel**
**Tenterden, Kent, England**

*It's nice to see that computers have become a mind-expanding hobby for you too. As for the expiration code our subscription fulfillment service uses, here is an explanation:*

123456 03 8301
JONES, JOHN D

*The first number above the name is an in-house sequence number which identifies you. The second, two-digit number is the number of that issue, i.e., 03 is for the March issue. The third group of four digits is your expiration issue, i.e., 8301 would indicate that the January 1983 issue is the last of your subscription. Along with all this, of course, we always encourage everyone to renew early because it saves loads of paperwork. I hope this helps, and am glad you enjoy the magazine. — Ed.*

My hat is off to Alan Simon for his article, Menu-80, in the March 1982 issue. For LDOS users *(here)* is one small change for line 130:

```
130 D=PEEK(15388)—48
```

The program will now see the right drive number on the screen. And I added a short subroutine so I could put this program on my system disk in drive 0 and select the menu from any drive:

```
 80 DIMA(26):GOSUB350
350 REM EDIT LINE 380 FOR
TOTAL NUMBER OF DRIVES
360 PRINT@530,"SELECT
DRIVE MENU — ";
370 X$=INKEY$:IFX$=""THEN
GOTO 370
375 X=VAL(X$)
380 IFX< 0 OR X >1 THEN
PRINT@ 594,"NO SUCH DRIVE!":
GOTO 360
390 CLS
400 ONX+1GOTO410,420,430,440
410 CMD"DIR :0":RETURN
420 CMD"DIR :1":RETURN
430 CMD"DIR :2":RETURN
440 CMD"DIR :3":RETURN
```

and just one more modification for those who change their minds:

```
275 PRINT@773,"Z) TO SELECT
ANOTHER MENU — ";
285 IFV="Z"THEN GOTO 60
```

Thanks for letting me share this with your readers, and thanks to you at 80-U.S. for the fine magazine you publish.

**John Gunsett**
**San Pedro, CA**

*And thank you John, for the good information you have given here. — Ed.*

---

...Please pass on to Spencer Hall that my experience with the Stringy Floppy parallels his except mine ran 100% from start up and is absolutely a thrill to use. I guess I'm a satisfied user as I've purchased a number of other Exatron software items including the FMS program (a super file handling program) and the ESOS 2.4 (a slow disk simulator for stringy which has a number of powerful intrinsic routines such as renumber commands, merge, sound frequency and duration generator, lower case, and screen dump plus more, all for $35.00! I, too, simply use cassette for archival copies and my only problem with Stringy is running out of wafers!

While I'm at it I would like to comment on the new monthly format. I find myself unable to absorb all of this material on a monthly basis. Bimonthly was fine for my needs. More often than not I return to back issues to refamiliarize myself with the contents and something new will pop out...

**Tim Bowman**
**Spokane, WA**

*Sounds like the Stringy is indeed an @SUCCESS. Loading and saving at 7200 baud is a real step up after audio cassettes. — Ed.*

---

...As a retired person from 25 years as Director of Research for *Modern Medicine* (Minneapolis, MN) a publisher of medical journals, I get a real kick out of reading your vagaries of a growing advertising publication. We experienced many of the problems you are meeting. And I do find your editors selection and handling of articles most helpful in my current microcomputer hobby. Just keep on experimenting and changing — *but* don't change too much and too fast.

**Al Hubbard**
**Ft. Myers, FL**

*We have been pulling ourselves up by the bootstraps for some time now and enjoy doing it as much as you enjoy watching it! There are many improvements to come; so many in fact, that it sometimes boggles the mind thinking of them. Will it all end with "electronic mail"? We don't know, but it's sure fun trying to anticipate and speculate. As far as going too far to fast: When you start from zero you sometimes need to double up to catch up. — Ed.*

---

The January 1982 issue of your journal is the first that I have seen and bought. I am entranced with the concept of listing variations in programs to fit the different TRS models. I own a Color Computer (16K Extended BASIC).

Spencer Hall's article has a typical error in subroutine 42 — erase contents of box drawn by 41 but leaves the box. You always have to restore the end of the line erased and whatever follows. The simplest change I could make without disturbing the original numbering system was:

a) delete line 118
b) change line 41 to: 41 GOSUB 115: GOTO 143
c) change line 42 to: 42(original line): GOTO 119
d) add line 143: 143 PRINT@PZ, ZT$;:GOTO 119

I am disappointed that the Fun 'n Games, Hog Jowl Mansion, will not work on my 16K Color Computer.

The article on expanding Color Computer memory by R. Wayne Day was perfect.

How about a program for joining two or more programs from cassette? How about a subroutine for changing the position of a program line? These are the two things that I need the most at the moment (or a cassette editor).

**Joseph P. Laronda**
**Cheshire, CT**

*Hang in there. The routines you want will probably show up shortly and we will report on them as they do. — Ed.*

---

Thanks for your recent assistance (and courtesy) when I called for some subscription information. I have received my first issue and am very pleased.

There are a lot of us Color Computer rookies out here who need all the help we can get. Your articles are helpful and program listings for the Color Computer are really appreciated. The more, the better. Good information for this machine is still a bit scarce.

Something that would be very helpful to many of us would be information pertaining to limited, inexpensive systems. For instance, in your recent word processing articles, a fine product that would have been appropriate is C. C. Writer. It is a very low cost, cassette word processing program written in BASIC — it doesn't require disk, is user modifiable, and in general a terrific little package for a small system.

Also, it's great that you have gone to a monthly. I hardly have time to digest all that info in one month, but it is is fun trying.

**Gary Burkhardt**

# Items at random

It's May, and spring has finally sprung. The proofreaders have just finished proofing this issue and have walked away shaking their heads and saying that if we keep this up we might have a magazine! Their attention to detail is amazing, but they still miss a few now and then. Corrections to previous issues follow.

### Corrections

In the March issue we published a short program and article called "Clean those disk heads". The listing allows the disk drives to continue rotating during the entire cleaning process. The program will not work on the Model III because disk drive operations require input and output to a port address as opposed to a memory location as on the Model I. Listing 1, below, will allow Model III users to accomplish the same disk cleaning task. Our thanks to Robert E. Brown of Schenectady, New York, for this input.

Also in the March 1982 issue, page 48 contained an article "Laying it on the line" and has a flaw in the listing. Lines 110 and 120 should read:

```
110 NEXT Y2
120 NEXT X1
```

instead of:

```
110 NEXT Y1
120 NEXT X2
```

As printed, the listing will give you a NF? error.

The text pertaining to the "Payback" program listing on page 30 of our April 1982 issue has a error. Specifically, the third paragraph should read:

"Payback will neither strain your machine's memory (it runs in less than 700 bytes) nor wear out your typing fingers (only 14 program lines). It runs on all models. For Model II, change CHR$(243) in line 50 to SPC(67). )Ed. Note — For Model II, also remove the :PRINT@64, CHR$(31) in line 150)." It seems we renumbered the program after the text had been edited and line number references no longer corresponded. We are sorry if this caused you a problem.

### Reader survey

If you haven't yet completed the reader survey in the April issue, please do so soon. We are anxious to tabulate the results. Your answers will determine, to a large extent, the direction and content of this publication. Although we like to improve and fine tune the production, the editorial content should be dictated mostly by you, the readers.

**Listing 1**

```
5 ' *** CLEAN1/3   REVISED BOB BROWN 3/1/82
10 ' *** INSERT # OF LAST DRIVE (0-3) ON YOUR SYSTEM (BELOW)
15 LASTDRIVE=1
20 CLS:PRINT:PRINT "REMOVE ALL DISKS FROM DRIVES AND PRESS <ENTER>";:INPUT A
25 FOR N=0 TO LASTDRIVE:IF N=0 THEN DR=1 ELSE IF N=1 THEN DR=2 ELSE IF N=2 THEN
DR=4 ELSE IF N=3 THEN DR=8
30 ' *** DETERMINE IF MOD 1 OR MOD 3
35 IF PEEK(293)<>73 THEN M=1 ELSE M=3
40 ' *** SELECT A RANDOM TRACK FOR HEAD POSITIONING
45 IF M=1 THEN TR=RND(35) ELSE TR=RND(40)
50 ' *** SELECT THE DRIVE
55 IF M=1 THEN POKE 14304,DR ELSE OUT 244,DR
60 ' *** ISSUE "RESTORE" TO MOVE HEAD TO TRACK 0
65 IF M=1 THEN POKE 14316,3 ELSE OUT 240,3
70 ' *** LOOK FOR FDC "NOT BUSY" STATUS
75 IF M=1 THEN ST=PEEK(14316) ELSE ST=INP(240)
80 IF(ST AND 1)=1 THEN75
85 ' *** SELECT DRIVE AGAIN
90 IF M=1 THEN POKE 14304,DR ELSE OUT 244,DR
95 ' *** MOVE HEAD OUT SOMPLACE
100 IF M=1 THEN POKE 14319,TR ELSE OUT 241,TR
105 IF M=1 THEN POKE 14316,19 ELSE OUT 240,19
110 ' *** CHECK FDC STATUS AGAIN
115 IF M=1 THEN ST=PEEK(14316) ELSE ST=INP(240)
120 IF(ST AND 1)=1 THEN115
125 PRINT"INSERT CLEANER DISK IN DRIVE #";N;" THEN HIT <ENTER>";
130 INPUT A
135 ' *** ACTIVATE DRIVE FOR ABOUT 30 SECONDS
140 FOR I=1 TO 3300
145 IF M=1 THEN POKE 14304,DR ELSE OUT 244,DR
150 NEXT I
155 NEXT N
160 PRINT"*** CLEANING COMPLETED ***":END
```

### In this issue

The theme of this issue is space. Our cover artist, Thomas Scott Nelson, did a wonderful job with Saturn. This is his second cover for us (the first was in March 1982). We found it very interesting that the Jet Propulsion Labs were using a TRS-80. Harry Avant wrote the lead story, and it appears on page 16.

With all the hoopla of the world coming to an end in March (we didn't believe it either), Terry Dettmann wrote a planet location program for the Color Computer. It gives the date and the relative angular position of the nine planets. It is a very interesting program to watch, and no, the planets did not line up in March. You can see it for yourself.

Finding where the satellites are is the subject of an article by Dana Waldman and Mark Felton on page 19. Let's see — if you point your antenna properly, you might get foreign television broadcasts (and reruns of "I Love Lucy").

Yes, Delmer, we finally found a home for your article, "Spaceship Orbitor". Delmer Hinrichs submitted this article so long ago I blush in thinking about it. We finally found an issue into which we could fit it. Not just another Lunar Lander, this program has all the realistic aspects of a real landing on four different satellites or the planet Mars. You have to be good, and learning to land on one of them does not guarantee a safe landing on another. It's tough, but also fun.

Solving simultaneous linear equations is the subject of an article and program by J. C. Adams, Jr., Ph.D., on page 34. It is always nice to see the computer take the grunt work out of math, and this article does it well.

Fred Blechman presents a small business invoice program on page 42. His program earlier this year, on a 12-column ledger, has drawn considerable interest and we are sure this one will too.

There is more too, see the table of contents. We hope you find it as interesting as we did. Make your days good ones, and tell everyone that you saw it in *80-U.S. Journal.*

**Mike**

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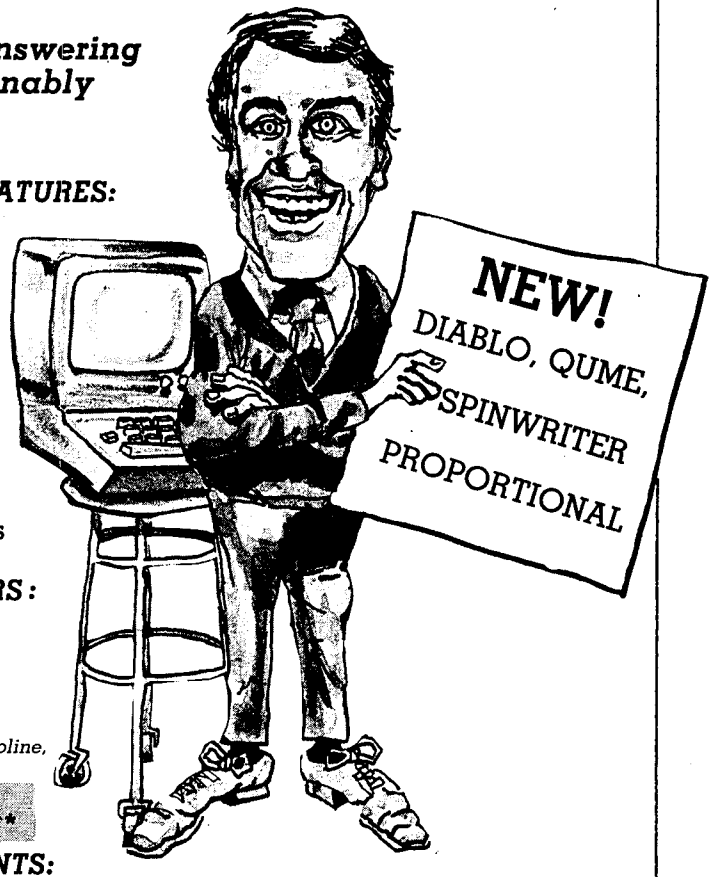


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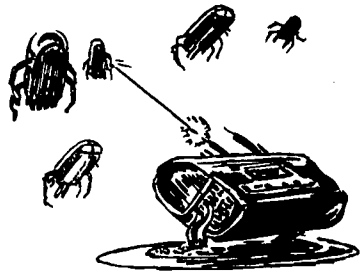
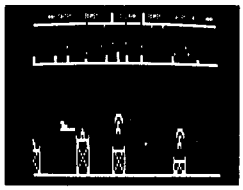
## DEFENSE COMMAND



By Hogue & Konyu from Big Five
You are the lone defender of 10 Krotnium fuel cells essential for the survival of the planet. Aliens swoop down from above to steal the fuel; it's your job to destroy them. You can still save the cells after a raid, but you must shoot the alien and simultaneously move under the cell to catch it. If things look bad you can set off one of your 4 antimatter bombs and destroy all enemies on the screen!

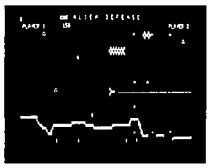
16K tape...$15.95 32K disk...$19.95

## ELIMINATOR



By Westmoreland & Gilman from A.I.
You'll need all your keyboard manipulative skills to keep up with the action in this arcade game. You travel across the planet's low-altitude airspace in an effort to prevent the marauding enemy from capturing your energizer cells. All manner of alien craft await your arrival with destructive forces. For 1 or 2 players, with sound.

32K disk...$24.95



## ALIEN DEFENSE

By Larry Ashmun from Soft Sector
Piloting your ship across the horizontally moving terrain, you must battle the various enemy spacecraft. You are under attack almost constantly, and to make matters worse, your ground patrol people are being picked up by the alien landers. To save them, you must shoot the landers and "catch" the falling man. This fast action game requires skill and rapid reflexes. The model III version uses that model's special graphic features.

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## SKY WARRIOR

By Roger Schrag from A.I.
Your job is simply(!) to pilot your ship through a tortuous, horizontally scrolling maze, avoid or destroy the many enemy missiles that are constantly being launched against you, then find and destroy the alien fuel dumps. All the while, you must constantly monitor your dwindling fuel supply or risk an untimely end. 1 or 2 players, with sound.

16K tape...$14.95
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## Instant Search/Sort DATABASE

By G. Hatton from Acorn
An easy-to-use, yet powerful database management tool, ISS alleviates many of the complications usually found in setting up and maintaining information files. Written in machine language, ISS can provide a multitude of sorts, subsorts, searches and categorizations in seconds. Because the processing is done in memory, you can manipulate the data at will without risk to your database on tape or disk. The number of records is limited only by your file format and the amount of RAM in your system.

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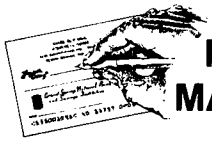

## MONEY MANAGER

By Andrew P. Bartorillo from Acorn
A complete management tool for the home budget, it accurately keeps track of your checkbook and provides an easy method of budget allocation. You can store information on up to 100 checkbook entries per month (250 with 48K), specify any automatic withdrawals, keep records of tax-deductibles, and record expenses by category. You can even break up charge account payments into the proper categories.

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## Data File Programming

By Finkel & Brown from Wiley & Sons
This self-teaching guidebook, written in clear, non-technical language, leads you at your own pace through the intricacies of data file programming and maintainence. Once learned, data file manipulation is the key to virtually all programming in the business and classroom environment. The book helps you set objectives and self-tests you on your progress toward them.

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## asylum

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By Sparky Starks from Adventure Int.
As mercenary and galactic police officer, you must maintain the condition and control of all parts of your spacecraft. Suddenly something appears on your screen: is it a Star-pirate or a friendly merchant ship? You can't tell yet, and at this speed you may have only a fraction of a second to make an attack/no attack decision.

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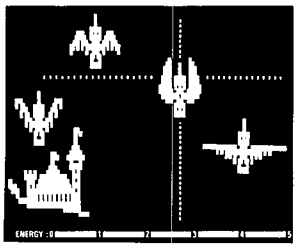
You get a vast lunar landscape, graphically depicted in both long range and close up, with many choices for landing sites. Choose a more difficult site and get more points -- if you can land successfully. Great graphics and sound add to the realtime challenge and fun.

16K tape...$14.95

## VOYAGE OF THE VALKYRIE



By Leo Christopherson from AOS
Combine the animation and music techniques pioneered by Christopherson with the challenge of his first fast-moving arcade game and you have VOYAGE OF THE VALKYRIE! You speed through a magical maze guarded by ferocious birds that swoop down to attack if you don't get them first. To list all the play and options of this exciting game would take the 16 pages of instruction included.

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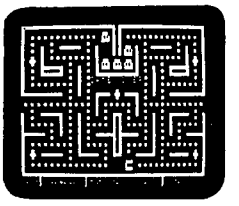
## SCARF-MAN



From Cornsoft Group
Race your Scarfman around a maze, gobbling up scoring dots. You are pursued by five monsters: if you eat a "+" they'll lower their eyes and you can eat them, otherwise they'll eat you! SCARFMAN may be played using the keyboard or Alpha Product's Joystick. WARNING: MAY BE HABIT-FORMING!

Tape...16.95
Disk (specify mod. I or III)...$20.95
Alpha Joystick:
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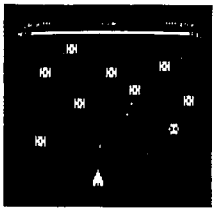

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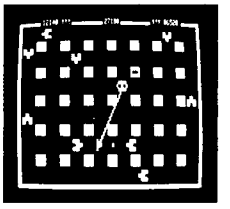

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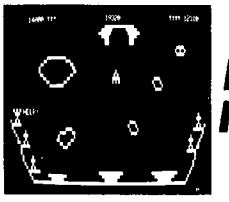

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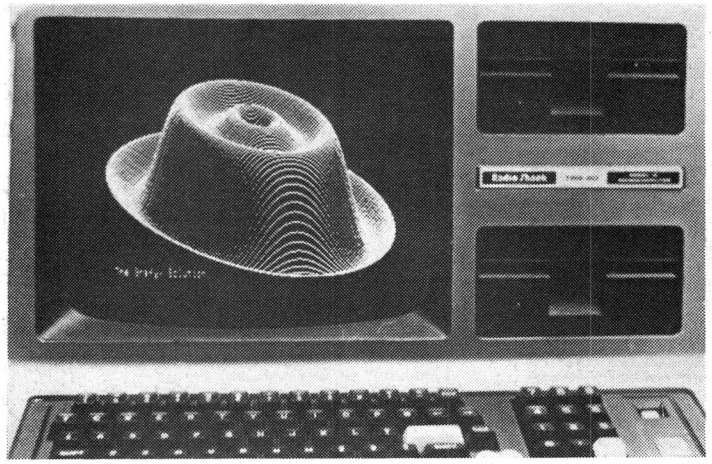


### Micro Yellow Pages

Micro Yellow Pages is a 32-page software directory/newsletter describing over 50 business software packages by Micro Architect Inc.

Micro Yellow Pages had the first official issue dated September, 1978. The current issue describes several new packages for the IBM Personal Computer. For a complimentary copy of this newsletter, which features information on data base managers, inventory control and complete business systems, contact Micro Architect Inc., 96 Dothan St., Arlington, MA 02174. For immediate response, send a #10, self addressed, stamped (37 cents), envelope. Or,

**Circle #126**

### New Color Computer game

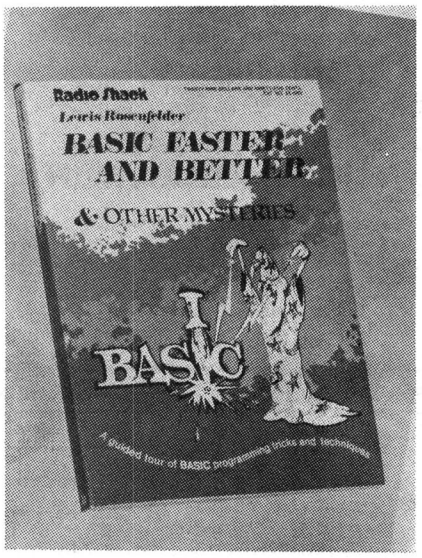
Circus Adventure, for the Color Computer is a game which provides a pleasant and positive approach to introducing children to the computer. The game runs on the 16K Color Computer. No extended BASIC or joysticks are required. It sells for $10. from Computer Island, 227 Hampton Green, Richmond, NY 10312

**Circle #129**

### Radio Shack adds BASIC Faster and Better to library

Radio Shack now offers programmers of the Model I, II and III a comprehensive volume of advanced information on techniques for effective and efficient programming in BASIC. BASIC Faster and Better & Other Mysteries (62-1002) by Lewis Rosenfelder, is available for $29.95 at Radio Shack Computer Centers, stores and participating dealers.

The author, a recognized programming authority, reveals innumerable short cuts, secrets, bits of what the author calls "trickery" and helpful hints for high efficiency, plus other advanced programming techniques. He offers extensive information on many topics, including shell programs, USR routines, "magic" arrays, strings, searches and sorts, utilities, number crunching, overlays, bit manipulation, memory mischief and more. In addition, a number of useful tables and listings have been incorporated into 11 appendices to this huge (8½ x 11 inch, just under 300 page) reference, and an extensive subject index has been provided.




### Model III Hi-res

The Grafyx Solution gives any configuration of a TRS-80 Model III a resolution of 512 x 192 for a total of 98,304 individually accessible points. The included graphics package allows you to set and reset points, lines, rectangles, and complement or clear the screen using simple BASIC commands such as PLOT and LINE. Alternate resolutions of 256 x 192, 128 x 192 or 128 x 96 are also possible.

When enabled, the hi-res graphics screen is displayed on top of the normal character display. The Grafyx Solution is an add-on circuit board which contains 12,288 bytes of additional read/write memory that does not conflict with the TRS-80 address space. Upgrading your computer requires no soldering and is as easy as clipping on some microclips, cutting one trace and removing two IC's from sockets.

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### New word processor

Transformation Technologies has announced its C. C. Writer word processing program for the TRS-80 Color Computer and the Radio Shack or Exatron disk systems. Disk C. C. Writer retains all of the features of the popular cassette C. C. Writer program plus adds features made possible by disk. Disk CCW allows full control of the margins, page length, line spacing, centering, justification and most features of "smart" printers. The powerful editing features allow changes, insertions, deletions and moves anywhere in the text. Files may be chained together for extended printing. Disk C. C. Writer requires 32K, Extended BASIC, and one Radio Shack or Exatron disk drive. Disk C. C. Writer is $40 from TransTek, 194 Lockwood, Bloomingdale, IL 60108

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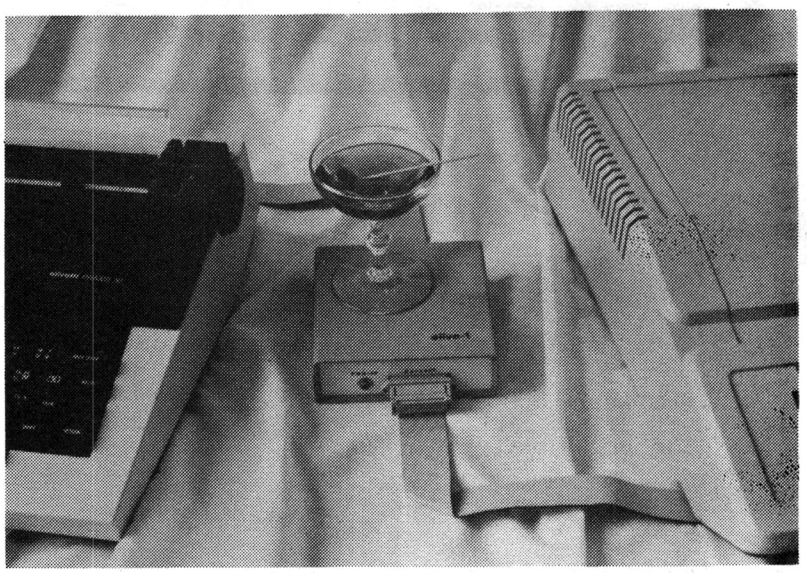
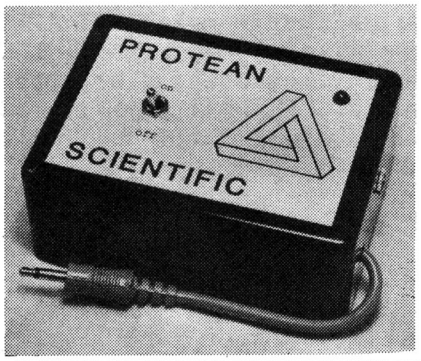
### Daisy wheel printer under $700

Model Olive-1 Interface turns Olivetti Praxis-30 or -35 electronic daisy wheel typewriter into letter quality printer with RS-232C computer interface. The Model Olive-1 Interface is available completely assembled and tested, with interface cables and detailed instructions for attachment to Praxis-3X, typewriter function is unimpaired, priced below $200; 9 VCC/300 ma wall socket plug-in power supply is optional. The Model Olive-80 Printer Package, including the Praxis-30 and Olive-1 Interface plus full documentation, is priced below $700. The package with the Praxis-35 is slightly higher. For more information contact The Olive Branch Association, Ltd., 1426 W. Winton Ave., Hayward, CA 94545 (415) 887-4716

**Circle #130**






### Pocket Computer interface

With the Protean Scientific PTR Interface you can now use the TRS-80 Pocket Computer as a portable data logging device and transfer your data quickly and easily to a TRS-80 desktop unit.

The complete PTR package is being introduced at $99.95 plus $2.50 shipping and handling. To order or for more information contact Protean Scientific, Route 13, Lincoln, NE 68527

**Circle #131**

### New coupon shopping program

Softbyte Computing has organized a way of keeping records of redeemable coupons. Up to 99 coupons, their brand names, values and expiry dates can be stored.

A stored list of 160 grocery items (more can be added) is available and shopping lists from these and a symbol next to items having a coupon will appear. The program will total up coupon deductions. Available on cassette for TRS-80 Model I and III for $9.95 from Softbyte Computing, PO Box 217, Wallingford, CT 06492

**Circle #128**

### New RS232C Interface

VR Data is proud to announce the availability of the VR-RS232C. The VR-RS232C is a plug-compatible serial interface for the TRS-80 Model III. It features a programmable baud rate generator from 50 to 19,200 baud, fully interrupt driven, programmable pin out to eliminate special cables (modem output standard), reverse polarity protection, programmable UART, user prototyping area for special applications such as 20 ma current loop, relays or lamp drivers. Internal installation can be made with simple hand tools. No soldering or other component level work is required. Retail price is $75.00. VR Data Corp., 777 Henderson Blvd., N-6, Folcroft Industrial Park, Folcroft, PA 19032 (215) 461-5300

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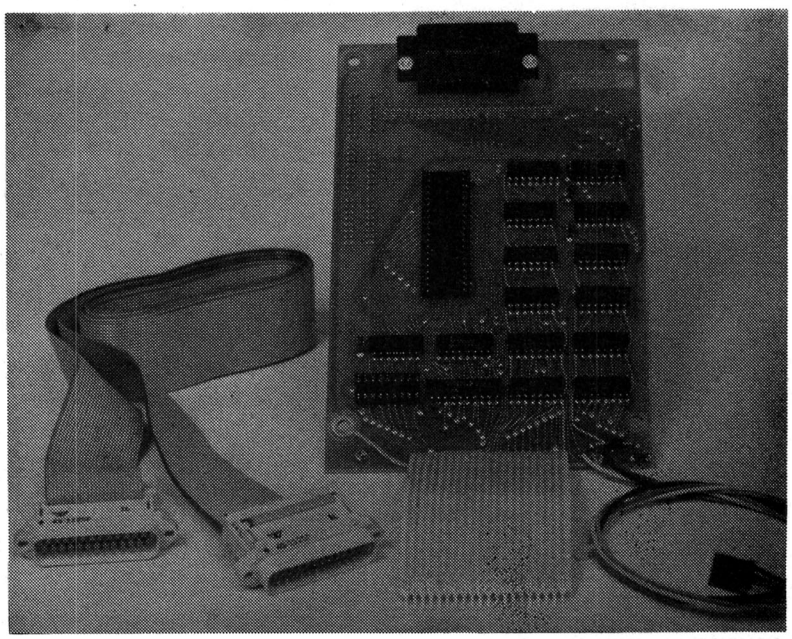

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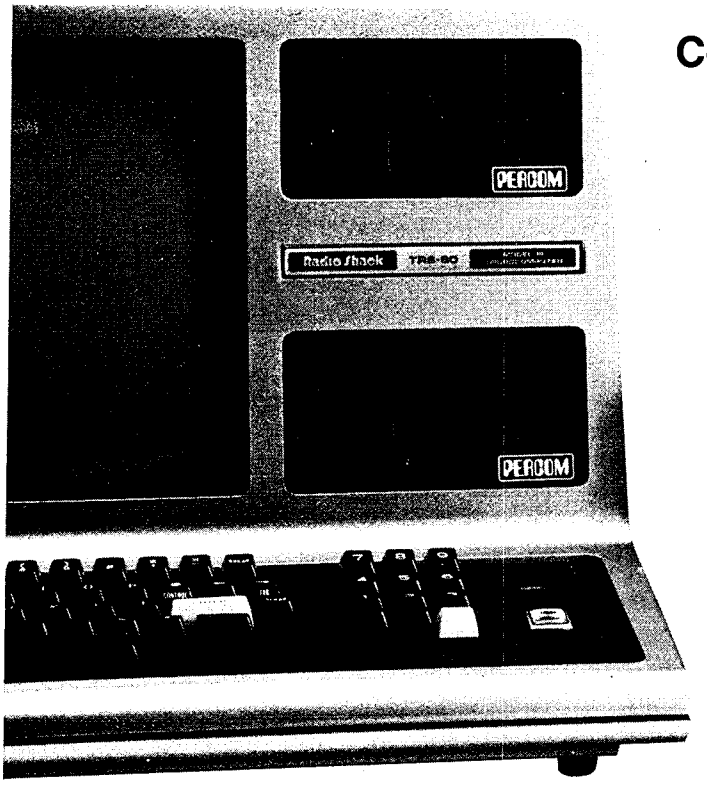


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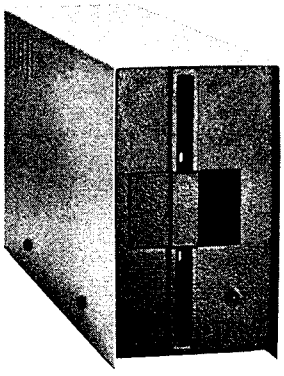

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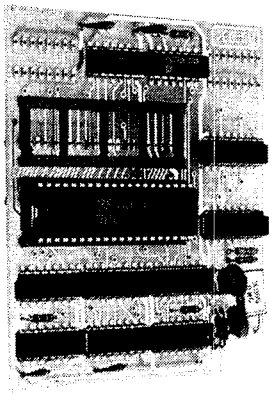

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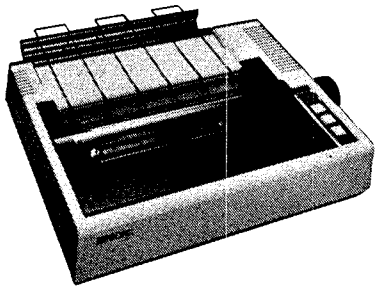

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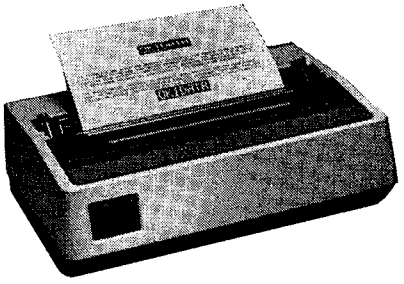

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# Space photography at J. P. L.

## *Jet Propulsion Laboratories uses TRS-80 interface to photodensitometer*

Harry Avant, La Crescenta, CA

This article describes a hardware interface that is currently being used in the Mission and Test Photo System of the Jet Propulsion Lab in Pasadena, California. A TRS-80 microcomputer is used in conjunction with the hardware described to acquire, store and manipulate photographic density and temperature data in a high volume photographic processing facility. The data is generated in conjunction with the production of photographic images from unmanned interplanetary spacecraft such as Voyager. The interface provides for 24 bits of I/O that can be expanded to 96 bits if required.

### Introduction

During the past two or three years, small "personal" type computers have been utilized in increasing numbers within large industrial-type environments. One of the more common applications for these types of computers is in the area of equipment and process control.

This article describes an interface that is currently used to couple photographic densitometers and a temperature indicator to a TRS-80. A view of the equipment is shown in photograph 1.

Attached to the TRS-80 are the following: two densitometers (only one is shown in this view), a second monitor, three disk drives, one cassette recorder, a Radio Shack Line Printer II, an Axiom 801P printer, a Micromint I/O port with parallel and 232C ports, a Micromint Digitalker, constant voltage transformer, line spike suppressor, and finally, the interface that is described in this article. This interface is the long box just above the TRS-80 monitor. At first glance, it appears that we have made an effort to see just how many things can be attached to a TRS-80, but each of the items is extensively used on a daily basis.

This equipment is located within the Mission and Test Photo System (MTPS) group of the Photo Lab located at the Jet Propulsion Laboratory in Pasadena, California. The Mission and Test Photo System is a high volume photographic processing facility dedicated to the production of black and white photo products from unmanned interplanetary experiments. Products produced by the MTPS are used for scientific investigations, which places stringent requirements on the facility to maintain very high standards in terms of quality control.

The MTPS produces 5 by 5 inch film (both negatives and positives), 5 by 5 inch contact prints, and 10 by 10 inch enlargements. This facility is capable, over short periods, of producing up to 65,000 pieces per week, although 35,000 per week is more typical. In addition to production requirements, MTPS also assists in the calibration of digital film recorders that convert data to photographic film.

In order to adequately monitor quality of the items produced, huge amounts of data are acquired. As an example, during the recent Voyager exploration of Jupiter, more than 15,000 density measurements were made on various tests, and chemical process monitoring. (Density as used here refers to photographic density which is a measurement of how dark a photographic image is. The instrument used to measure density is called a densitometer.) These measurements were made over a period of sixteen months in conjunction with production of 800,000 of the photographic products described above. When faced with 30,000 numbers to describe the quality of 800,000 products, a computer becomes very necessary!

### Background

Prior to 1977, data from various measurements was being hand copied onto pre-printed forms which were stored by category in three-ring notebooks—many notebooks, I might add. In order to utilize the data, it was necessary to enter it into conventional calculators for computations. Not only was this very slow, but offered the chance for error both in entering data into the

notebook records, and reentering it into a calculator.

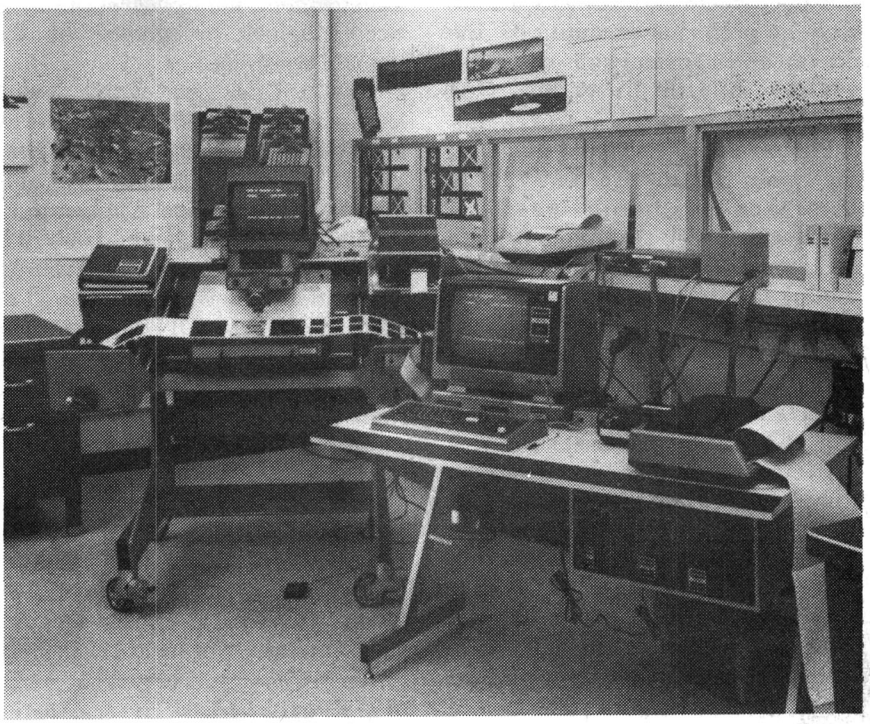
In an attempt to partially automate some calculations, a dumb terminal communicating with a very large main frame computer was utilized. Data from notebook records was entered into a data base resident in the main frame. This was some improvement in that the data base was able to perform complex sorting and limited statistical analysis.

As anyone who has ever had to contend with time sharing on a large system knows, access was not always possible. Many times when data was needed in a hurry, it was necessary to wait to gain access. In addition, a very large computer's time is not inexpensive. We soon discovered that on-line terminal time per year could easily cost more than a small stand-alone computer system. A main frame was not helping with the problem of human errors, either. There was still the occurrence of erroneous entries into notebooks and more errors in reading notebook data and entering it into the computer.

Our next consideration was the possibility of interfacing some measuring equipment directly to the main frame. This was rejected, based on hardware cost of interfacing equipment. There was still the problem of access to the main frame.

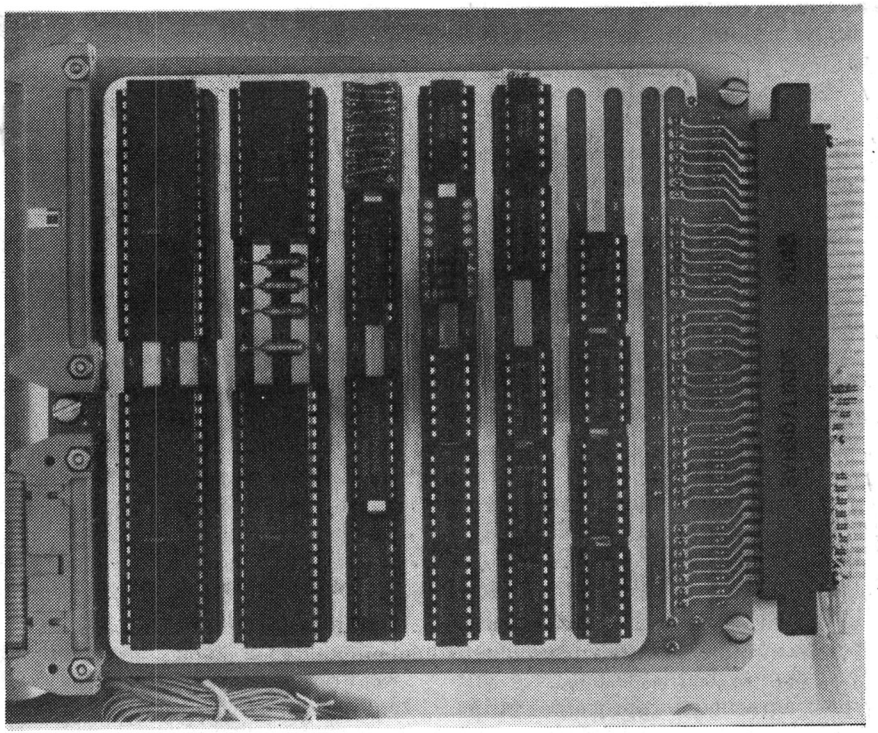
We considered the possibility of acquiring a small computer, interfacing it with some measurement equipment and storing data on disk or tape for later transmission to the main frame through modem. An investigation of probable costs, again, of using a large computer to store and manipulate data, lead us to the decision to do it all with a small computer.

A 48K two disk TRS-80 Model I was purchased by the lab and training of quality control personnel in BASIC language programming began. A simple prototype interface, using an 8255 programmable interface chip, was constructed as well as a "densitometer simulator." The prototype seemed to function quite well and it was installed in the lab for a couple of weeks to determine how well the TRS-80 and its



**Overview of the equipment setup in the MTPS. Photograph provided through the courtesy of the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.**

**Photo 1**



**Detail photograph of main circuit board in interface. Photograph provided through the courtesy of the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.**

**Photo 2**

interface would perform. Since there were no problems encountered, the design and construction of a final version of the interface was initiated.

Photo 2 shows the parts layout of the main board. Currently, this interface is being used in conjunction with two photographic densitometers and an eight-channel digital temperature indicator. One of the densitometers is a MacBeth model TD504 transmission type and the other is a MacBeth model TR527 reflection type. Both of these are digital readout instruments utilizing three, seven-segment numerical displays each, and equipped with BCD digital outputs on their rear panels. An interesting feature of the BCD outputs is that they are negative logic—a (one) is false, and a (zero) is true.

Each densitometer is equipped with a nine-column printer to provide hard copy records of measured density. The nine-column printers are designed to accept BCD data and are directly coupled to the output of each densitometer with no external interface. The digital temperature meter is a four-digit liquid crystal display equipped to handle eight temperature sensors.

There are seven high speed film and paper processors in the lab. Each one is monitored by a separate sensor, with one sensor unused. This meter also has BCD information brought out to the rear panel. In addition, the temperature indicator is multiplexed by a three-bit "word" to allow it to read any of the eight temperature sensors. Sensor selection may also be controlled by a front panel switch on the meter.

### Hardware Description

Three 8255A programmable interface chips provide the heart of the circuit. Although the 8255 was designed with the 8080 microprocessor in mind, it is a general purpose I/O device that is compatible with most current microprocessor chips. An 8255 provides 24 I/O lines that may be configured in various groupings by supplying an appropriate control word. Four ports are available as I/O for this device, two with eight bits each, and two with four bits each. Independent port programming is accomplished by choice of the control word used.

Intel, the designer of this device, publishes an excellent application and data sheet, Application Note AP-15, "8255A* Programmable Peripheral Interface Application." As stated in the application note, it is possible to program the device as three independent ports, as well as several other useful configurations by proper choice of the control word used. In this application, a control word (155 decimal) is used to configure the chip's three, eight-bit ports as input only, with each port operating independently of the others.

The 8255 chips are memory mapped into a region of two thousand bytes of unused memory locations which start at 12288 (3000 Hex) in a Model I. Memory mapped addressing was selected because it allows for a very large number of locations to be used and does not interfere with some of the port addressed devices that are also used with this particular configuration.

***At first glance, it appears that we have made an effort to see just how many things can be attached to a TRS-80, but each of the items is extensively used on a daily basis.***

### Software

A complete discussion of the software used in conjunction with this interface is well beyond the scope of this article. What follows is a brief outline of the drivers used for programming the 8255s and converting the BCD data into binary form. A typical input and its conversion follows.

Assume that a densitometer reading of 3.45 occurs. The BCD equivalent of this reading is:

0011 0100 0101

However, the densitometer has negative true logic which results in:

1100 1011 1010

Considering the first two digits, 3 and 4, the 1100 1011 is equal to decimal 203, NOT 203 + 256 = 52, which in binary is:

0011 0100

AND with 15 (binary 0000 1111) then:

0011 1111 AND
0000 1111

result 0000 0100, or 4 in decimal, which is the middle digit.

Now, take the binary 52, and AND it with 240. We get:

0011 0100 AND
0000 1111

result 0011 0000, or 48, in decimal. If this is divided by 16, the result is 3, which is the leading digit. The most significant and middle digit has now been recovered. For the least significant digit:

0101 xxxx in binary
1010 0000 in negative true

This is equal to 160. A NOT(160) is equal to -161, and adding 256, equals 95, which in binary is:

0101 1111

This is ANDed with 240 as follows:

0101 1111 AND
1111 0000

result: 0101 0000, which is equal to 80 decimal. This is divided by sixteen to compensate for the positional factor, resulting in 5, which is the least significant digit of the original reading.

### Acknowledgements

I would like to acknowledge the assistance of the following: Mr. E. T. Lee, Photo Electronic Technician (MTPS), for his help in construction of the interface; Mr. D. J. Lee, Photo Quality Analyst (MTPS), who took the hardware and the simple software driver I supplied with it and integrated them into the overall MTPS software routines; and Mr. G. A. Praver (JPL), former Group Supervisor (MTPS), for his encouragement and foresight during all phases of this effort.

The research described in this paper was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Reference to any specific commercial product, process or service by trade name or manufacture does not necessarily constitute an endorsement by the United States government or the Jet Propulsion Laboratory, California Institute of Technology. ■

# Geosynchronous satellite pointing

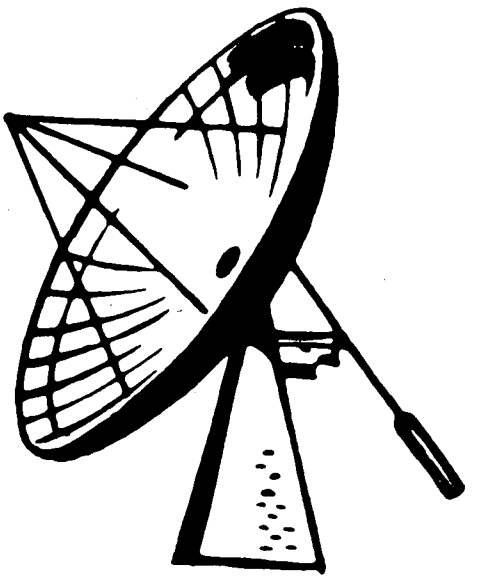
## Use spherical geometry to locate satellites

Model I/III

Dana Waldman and Mark Felton, Denver, CO

A major portion of the satellites that are used today sit in an orbit over the equator some 22,214 miles from earth. The reason for this orbital path is that satellites placed in this "geosynchronous" orbit will revolve with the earth, and therefore, remain continuously over the same spot on the earth. This fixed orbit makes pointing much easier, with no need to track the satellite. The telescope or antenna can be pointed only once, then locked into place.

For those involved in either amateur or professional antenna or telescope work, the question still remains, "How does one find the various geosynchronous satellites?" The program in this article was developed on a TRS-80 Model I using BASIC Level II and TRS-DOS. It uses spherical geometry to locate the "geosynchronous" satellites over the contiguous United States. It allows entry of up to 20 satellites and their longitudes into a satellite data file. The program uses this information to calculate the direction (azimuth) and elevation angle from the ground that the antenna or telescope should point to find the satellite. A list of satellites and their longitudes (west) in degrees are given below.



| Satellite | Longitude |
|---|---|
| Comstar 1 | 128 |
| Comstar 2 | 95 |
| Comstar 3 | 87 |
| Satcom 1 | 135 |
| Satcom 2 | 119 |
| Satcom 3R | 131 |
| Westar 1 | 99 |
| Westar 2 | 123.5 |
| Westar 3 | 91 |
| Anik 1 | 104 |
| Anik 2 | 109 |
| Anik 3 | 114 |

This program allows satellites to be added or changed to handle future changes in orbit.

Since the program requires the longitude and latitude coordinates of the location on the earth to tell how to point the antenna, you will need a source of longitudes and latitudes for the locations of interest. Most public libraries have an atlas which will give you the necessary information.

In addition, the program asks for the declination angle of your location. Declination angle corrects for the difference (slight) between the true North Pole (the northern point of the spin axis of the earth) and the magnetic North Pole (the place where a compass points when it says "north"). This angle can be obtained by calling the closest airport or a local surveyor.

The magnetic azimuth is the direction which includes the correction of the declination angle. If the declination angle is zero, the magnetic azimuth and the true azimuth will be the same. You should use the magnetic azimuth if you are pointing at the satellite with a compass. The true azimuth may be required if you are using surveyor's maps.

The outputs of the program's calculation are the true azimuth, the magnetic (compass) azimuth and the elevation angle. Most hardware stores have an angle measuring instrument called an inclinometer if your antenna or telescope won't give you the elevation.

Mathematically, the program is based on spherical geometry. If you draw the earth as a sphere, then locate the lines from the center of the earth to any location on the earth and outward through the equator to the satellite in orbit, the required geometry begins to emerge. Now, draw a tangential plane at the earth's location, draw a line from it to the satellite. With a little bit of knowledge of spherical geometry and ability to read the basic program, you can derive the equations.

The program is interactive and easy to operate. When the program is run, the main menu appears:

```
**** MAIN MENU ****
1. Azimuth & Elevation Calculation
2. Maintain Satellite Longitude Table
3. End Program
     Enter Function
```

Function 1 allows the entry of data into the file "SATFIL/DAT". This file will be created on your disk if it does not exist. At the prompt: ENTER SATELLITE NAME ( 'END' TO EXIT ), key in a name of up to 15 characters. To go back to the second menu, key in END. At the prompt: ENTER SATELLITE LONGITUDE, key in longitude, in degrees. The table will hold up to 20 satellites.

Function 2 of the second menu, displays the satellites on file. The satellites have been numbered automatically when entered. For example:

```
1    Westar 1    99
2    Westar 2    123.5
3    Westar 3    91
4    Satcom 1    135

WHICH SATELLITE # DO YOU WANT TO CHANGE
('0' TO EXIT).
```

To change the fourth satellite (Satcom 1), key in 4. The program asks for the satellite's new name and longitude, writes the new data back into the file, then redisplays the satellite table.

Now you are ready to use this data to calculate the azimuth and elevation angle. Go back to the main menu and choose Function 1. At the prompt: ENTER THE SATELLITE NAME, key in the name of the satellite at which you want to point. The program searches the satellite table for this name and, if no match is found, it will ask for the name again. When it finds the name in the file, it uses the longitude to calculate true azimuth, magnetic azimuth and elevation angle.

Here are some sample points and calculations:

```
NEW YORK                    WESTAR 1
  Lat.....40.78             True Az..... 215.574
  Long.....73.96            Mag. Az. ..... 227.954
  Dec. Angle .....-12.38    Elevatn..... 36.3181

CLEVELAND                   SATCOM 3R
  Lat. .....41.46           True Az..... 240.417
  Long.....81.61            Mag. Az. ..... 246.317
  Dec. Angle ..... +5.90    Elevatn..... 21.0826

BOSTON                      ANIK 1
  Lat. .....42.36           True Az..... 223.857
  Long.....71.08            Mag. Az. ..... 239.397
  Dec. Angle .... +15.54    Elevatn..... 30.877

DENVER                      SATCOM 1
  Lat. .....39.75           True Az..... 222.079
  Long..... 105.00          Mag. Az. ..... 210.229
  Dec. Angle .....-11.85    Elevatn..... 34.5937

PHOENIX                     WESTAR 3
  Lat. .....33.48           True Az..... 145.084
  Long..... 112.06          Mag. Az. ..... 132.294
  Dec. Angle .....-12.79    Elevatn..... 44.9678

LOS ANGELES                 COMSTAR 3
  Lat. .....34.05           True Az..... 132.698
  Long..... 118.25          Mag. Az. ..... 118.488
  Dec. Angle .....-14.21    Elevatn..... 38.2805
```

*Dana Waldman (programmer) and Mark Felton (communications engineer) have worked together for a number of years on the technical staff of International Communications Experts, Corp. Dana Waldman presently works for Automated Business Systems, Inc. Mark Felton is employed in the Denver office of Scientific Atlanta (cable division).*

*A complete version of this program on disk can be obtained by sending $65.00, your name and address to: SATCALC/BAS, 1128 Bannock St., Denver, CO 80204.*

**Program Listing for Geosynchronous Satellite Pointing**

```
10 REM SATCALC/BAS
20 REM GEOSYNCHRONOUS SATELLITE
30 REM POINTING PROGRAM
40 REM
```

```
50 REM          MAIN MENU
60 OPEN "R",1,"SATFIL/DAT"
70 FIELD 1, 15 AS SA$, 8 AS SL$
80 REM  SATFIL/DAT RECORD - SA$ 15 CHAR
   SATELLITE NAME
90 REM                          SL$  8 PLAC
  ES FOR SAT LONGITUDE
100 CLS
110 PRINT @140,"****  MAIN MENU ****"
120 PRINT @262,"1. AZIMUTH & ELEVATION
  CALCULATION"
130 PRINT @390,"2. MAINTAIN SATELLITE L
  ONGITUDE TABLE"
140 PRINT @518,"3. END PROGRAM"
150 PRINT @646,"ENTER FUNCTION"
160 INPUT OPT%
170 ON OPT% GOSUB 860, 210, 1360
180 GOTO 100
190 REM
200 REM
210 REM   MAINTAIN SATELLITE LONGITUDE
  TABLE
220 CLS
230 PRINT @262,"1. ADD A SATELLITE"
240 PRINT @390,"2. DISPLAY/CHANGE SATEL
  LITE TABLE"
250 PRINT @518,"3. RETURN TO MAIN MENU"

260 PRINT @646,"ENTER FUNCTION"
270 INPUT OPT%
280 ON OPT% GOSUB 320, 500
290 RETURN
300 REM
310 REM
320 REM      ADD A SATELLITE
330 L%=LOF(1)             : REM  GET FILE
   RECORD COUNT
340 IF L%<20 GOTO 370    : REM  MAXIMUM
  OF 20 SATELLITES
350 PRINT "SATELLITE TABLE FULL - CANNO
  T ADD  (PRESS 'ENTER' TO CONTINUE)" :
   INPUT OPT%
360 GOTO 210
370 PRINT : PRINT "ENTER SATELLITE NAME
   ( 'END' TO EXIT )"
380 INPUT SN$
390 IF SN$="END" GOTO 470
400 PRINT "ENTER SATELLITE LONGITUDE"
410 INPUT SL#
420 LSET SL$=MKD$(SL#)
430 LSET SA$=SN$
440 L%=LOF(1)+1
450 PUT 1,L%      : REM WRITE TO DATA FI
  LE
460 GOTO 340
470 RETURN
480 REM
490 REM
500 REM        CHANGE SATELLITE TABLE
510 CLS
520 PRINT @10,"SATELLITE LONGITUDE TABL
  E"
530 L%=0    : REM RECORD #
540 V1%=2   : REM  LINE # ON CRT
550 V3%=0   : REM  TAB ON CRT
560 L%=L%+1
570 IF L%>LOF(1) GOTO 710
580 IF L%>20 GOTO 710
590 IF V3%=0 THEN V1%=V1%+1
600 IF V1%<14 THEN 620
610 CLS
620 V2%=(V1%*64)+V3%    : REM  GET PRINT
   POSITION
630 GET 1,L%
640 SL#=CVD(SL$)
650 PRINT @V2%,L%
660 PRINT @V2%+5,SA$
670 PRINT @V2%+23,SL#
680 V3%=V3%+34
690 IF V3%>34 THEN V3%=0
700 GOTO 560
710 PRINT @833,"WHICH SATELLITE # DO YO
  U WANT TO CHANGE ( '0' TO EXIT)"
720 INPUT OPT%
730 IF OPT%>LOF(1) THEN 710
740 IF OPT%=0 THEN 210
750 PRINT @833,OPT%," ENTER SATELLITE N
  AME                "
760 INPUT SN$
770 PRINT @833,OPT%,SN$," ENTER LONGITU
  DE  "
780 INPUT SL#
790 LSET SA$=SN$
800 LSET SL$=MKD$(SL#)
810 PUT 1,OPT%       : REM  WRITE TO DAT
  A FILE
820 PRINT @833,"
       "
830 GOTO 500
840 REM
850 REM
860 REM    CALCULATION ROUTINE (TRUE &
  MAGNETIC AZIMUTH, ELEVATION)
870 BL$="  "
880 GOTO 900
890 PRINT "SATELLITE IS NOT ON FILE"
900 PRINT
910 PRINT "ENTER SATELLITE NAME ( 'END'
   TO EXIT )"
920 INPUT SN$
930 IF SN$="END" THEN 1330
940 IF LEN(SN$)>15 THEN 890  : REM  NAM
  E CAN'T BE > 15 CHARS
950 IF LEN(SN$)=15 THEN 980
```

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**Circle # 7**




```
960 SN$=SN$+BL$    : REM   ADD TRAILING
  BLANKS FOR 15 CHAR NAME
970 GOTO 950
980 L&=0
990 L&=L&+1        : REM  ADD TO DATA FI
  LE RECORD COUNT
1000 IF L&>LOF(1) GOTO 890
1010 GET 1,L&      : REM   READ DATA FI
  LE
1020 IF SN$<>SA$ GOTO 990  : REM  IF NO
   MATCH, READ AGAIN
1030 SL#=CVD(SL$)
1040 PRINT SN$,"   LONGITUDE = ",SL#
1050 PRINT
1060 PRINT "ENTER SITE LATITUDE IN DEGR
  EES"
1070 INPUT L#
1080 PRINT "ENTER SITE LONGITUDE IN DEG
  REES"
1090 INPUT M#
1100 PRINT "ENTER ANGLE OF DECLINATION
  IN DEGREES ( - IF EAST, + IF WEST)"
1110 INPUT LD#
1120 S1#=SL#*0.0174533    : REM  SAT LAT
  ITUDE IN RADIANS
1130 L1#=L#*0.0174533     : REM  SITE LA
  TITUDE IN RADIANS
1140 M1#=M#*0.0174533     : REM  SITE LO
  NGITUDE IN RADIANS
1150 D1#=S1#-M1#          : REM  CALCULA
  TE TRUE AZIMUTH
1160 A1#=ATN(TAN(D1#)/SIN(L1#))
1170 AT#=180.0+A1#*57.2958
1180 AT!=AT#
1190 PRINT
1200 PRINT "TRUE AZIMUTH    ",AT!
1210 AM#=AT#+LD#    : REM  CORRECT TRUE
   AZIMUTH TO MAGNETIC AZIMUTH
1220 AM!=AM#
1230 PRINT "MAGNETIC AZIMUTH",AM!
1240 D2#=((COS(D1#)*COS(L1#))-0.15126)
  : REM  CALCULATE ELEVATION
1250 D3#=SQR(SIN(D1#)*SIN(D1#)+COS(D1#)
  *COS(D1#)*SIN(L1#)*SIN(L1#))
1260 D4#=D2#/D3#
1270 E1#=ATN(D4#)
1280 E#=E1#*57.2958
1290 E!=E#
1300 PRINT "ELEVATION       ",E!
1310 PRINT
1320 GOTO 900
1330 RETURN
1340 REM
1350 REM
1360 PRINT "PROGRAM END"
1370 CLOSE 1
1380 END
```

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# The Color Computer as a planetarium

**Color Computer with 16K extended BASIC, cassette or disk**

**T. R. Dettmann, Associate editor**

This illustration is a screen dump of the display generated with this program using a start date of 01,01,82 (January 1, 1982), an increment of 365 days, and a display of nine planets.

One of the fun things about working with the Color Computer is the graphics. Actually, they are quite easy to use.

In the way of simple introduction, we have included a program (in keeping with the theme of space articles) that displays the planets on your Color Computer.

The program will display successive positions of the planets at whatever interval you set. You can display any number of planets from one through nine. You will find though, that when you display all the planets, you can't tell one inner planet from another, since they all begin to wash out.

The program is written completely in BASIC. It illustrates a number of graphics functions: LINE, CIRCLE, DRAW, PCLS, SCREEN and PMODE.

Try typing the program into your computer and running it. It makes an interesting display including a running date displayed on the screen. (Look at lines 1040 to 1280 to see how it is done.)

To explain the program, let's look at the basic structure. After completing some necessary initialization (lines 10 — 270), the program goes to the subroutine at line 850 to display the desired planets.

### Interesting routines

Interesting graphics routines are located at the following lines:

540 — displays a planet.
790 — sets up for graphics screen.
850 — master graphics display routine.
1040 — data for numeral draw commands.
1140 — displays date on screen.

It should be made clear that this program isn't an attempt to provide state of the art graphics. It is an attempt to show an interesting application.

### The astronomy

There is no doubt that at least some of you are wondering how the program computes the position of the planets. Basically, the technique involves solving an equation (called Kepler's equation) and then plugging some numbers in a few standard formulae.

The subroutine at line 300 solves Kepler's equation by guessing a solution, and then using it to compute a better solution. This continues until new solutions are roughly the same as old solutions.

We have to do this because Kepler's equation can't be solved like you would an algebra problem. If you are really interested in the math, look at some of the more technical references listed at the end of this article. Otherwise, you can just forget there is any math involved and make believe there is some kind of black box which gets the planets' coordinates.

If you are really interested in the Astronomy, look at lines 60 to 140, which give the orbital elements for the planets. These are explained in any good book on Celestial Mechanics. If you have better numbers, by all means try them. The numbers used here are about 12 years old and of fairly low accuracy. They were chosen to have enough accuracy for the graphics display.

Only a few celestial phenomena were checked against the display — mostly relations between planets in the inner solar system. It would be interesting to hear about any more detailed checks that anyone is able to do.

The techniques used here are applicable for more than just the solar system. Other celestial bodies, such as the moons of Jupiter, Earth's moon, and even satellites around the earth obey these equations.

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A. E Roy, *Orbital Motion,* John Wiley, New York, 1978

J. R. Percy, *Observer's Handbook,* Royal Astronomical Society of Canada, 1980

*After you type and run this program there will be several prompts to reply to. The first will be for a date. You should enter a starting date that you wish the computer to use for the display of the initial planet locations. The next prompt will be for a calendar date increment. This number will tell the computer to display the planets according to the increment chosen. For example, if you enter 30 for the increment prompt, the computer will display the planets' positions every 30 days starting with the date entered for the first prompt. The last prompt will be for the number of planets you wish displayed. As explained in this article, you may enter up to nine planets, but those closest to the sun will be more closely grouped and the graphics clarity will suffer.*

*When all prompts have been answered, the computer will draw the planets in their relative positions with respect to the sun. The sun is indicated by the cross in the center of the screen. The planet closest to the sun will always be Mercury, the next Venus, then Earth, Mars, etc., according to how many planets you requested the computer to display.*

*The planets, in order from the sun, are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. — Ed.*

```
10 REM 80US PLANETARIUM
20 CLEAR100:PCLEAR4
30 CLS:PRINT"80-US PLANETARIUM"
40 DIM PL(9,6),MD(12),SC(9),SZ(9),NM$(9
),XY(9,2)
50 FORI=1TO9:FORJ=1TO6:READPL(I,J):NEXT
J:NEXTI
60 DATA 40945,4.0923,.2056,47.146,75.89
83,7.0042
70 DATA 40727,1.6021,.0068,75.780,130.1
639,3.3944
80 DATA 40587,.98561,.0167,0,101.220,0
90 DATA 40515,.52403,.0934,48.786,334.2
183,1.85
100 DATA 38398,.08309,.04845,99.442,12.
7167,1.305
110 DATA 31341,.0335,.05565,112.789,91.
0833,2.489
120 DATA 39265,.01173,.04724,73.39,169.
05,.7731
130 DATA 6499,.005981,.00858,130.68,43.
8667,1.773
140 DATA -42756,.003979,.250,109.73,224
,17.17
150 INPUT"DATE MM,DD,YY";MM,DD,YY
160 INPUT"DAY INCREMENT";DI
170 INPUT"NUMBER OF PLANETS(1-9)";MP
180 FORI=1TO12:READMD(I):NEXTI
190 GOSUB350:YR=1900+YY+DN/365
200 DATA0,31,59,90,120,151,181,212,243,
273,304,334
210 JD=15020:DR=3.14159/180
220 FORI=1TO9:READSC(I):NEXTI
230 DATA .6,1.2,1.8,2.5,6,16,35,50,50
240 SC=SC(MP)
250 FORI=1TO9:READSZ(I):NEXTI
260 DATA 3,3,3,3,5,4,3,3,3
270 FORI=0TO9:READNM$(I):NEXTI
280 GOSUB850
290 END
300 REM KEPLER'S EQN
310 M=DR*MU*(T-T0):ACC=.001:E=M
320 E1=M+EC*SIN(E)
330 IF ABS(E1-E)<ACC THEN RETURN
340 E=E1:GOTO320
350 REM JULIAN DAY
360 GOSUB410
370 T=JD+INT(365.25*YY)+DN
380 RETURN
390 REM DELAY LOOP
400 FORTM=1TO500:NEXTTM:RETURN
410 REM DAY NUMBER IN YEAR
420 DN=MD(MM)+DD
430 IF MM<3 THEN RETURN
440 IF INT(YY/4)*4=YY THEN RETURN
450 IF INT(YY/400)*400=YY THEN470
460 IF INT(YY/100)*100=YY THEN RETURN
470 DN=DN+1
480 RETURN
490 REM SOLVE FOR PLANET COORDS
500 GOSUB300
510 GOSUB690
520 GOSUB750
530 RETURN
540 REM DISPLAY PLANET
550 XX=127+127*(X/SC)
560 YY=191-(95+95*(Y/SC))
570 IF XX<0 OR YY<0 THEN RETURN
580 IF XX>251 OR YY>191 THEN RETURN
590 IF XY(I,1)<>0 THEN GOSUB650
600 XY(I,1)=XX:XY(I,2)=YY
610 CR=SZ(I)
620 CIRCLE(XX,YY),CR,1,1
630 PAINT(XX,YY),1,1
640 RETURN
650 REM BLANK OLD PLANET
660 CIRCLE(XY(I,1),XY(I,2)),SZ(I),0:PAI
NT(XY(I,1),XY(I,2)),0,0
670 CIRCLE(XY(I,1),XY(I,2)),1,1:LINE(XY
(I,1),XY(I,2))-(XX,YY),PSET
680 GOSUB810:RETURN
690 REM RADIUS & ANOMALY
700 A=((3548.19/3600)/(MU))^(.667)
710 X=A*(COS(E)-EC):Y=A*SQR(1-EC^2)*SIN
(E)
720 V=ATN(Y/X)
730 R=X/COS(V)
740 RETURN
750 REM XY COORD
760 X=R*(COS(OM)*COS(V+WM)-SIN(OM)*SIN(
V+WM)*COS(IN))
770 Y=R*(SIN(OM)*COS(V+WM)+COS(OM)*SIN(
V+WM)*COS(IN))
```

# PROGRAMMING TOOLS FOR YOUR TRS-80™

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## *Color Computer program*

```
780 RETURN
790 REM SETUP FOR GRAPHICS
800 PMODE4,1:PCLS:SCREEN1,1
810 REM CENTER MARK
820 LINE(127,90)-(127,102),PSET
830 LINE(121,96)-(133,96),PSET
840 RETURN
850 REM DISPLAY
860 IF CD<>0 THEN MP=CD:SC=SC(MP)
870 GOSUB790
880 GOSUB1140
890 FORI=1TOMP
900 T0=PL(I,1):MU=PL(I,2)
910 EC=PL(I,3):OM=PL(I,4)*DR
920 WM=PL(I,5)*DR:IN=PL(I,6)*DR
930 GOSUB490
940 GOSUB540
950 C$=INKEY$:IF C$<>"" THEN IF ASC(C$)
=13 THEN 1000 ELSE IF ASC(C$)=12 THEN G
OSUB790
960 NEXTI
970 YR=YR+DI/365:GOSUB1140
980 T=T+DI
990 GOTO890
1000 REM END DISPLAY
1010 CLS:RETURN
1020 REM END
1030 END
1040 DATA"R5;D7;L5;U7"
1050 DATA"BM+3,0;D7"
1060 DATA"R5;D3;L5;D4;R5"
1070 DATA"R5;D4;L2;R2;D3;L5"
1080 DATA"BM+4,0;N;G4;D4;N;R1;N;D3;L4"
1090 DATA"R5;L5;D3;R5;D4;L5"
1100 DATA"D7;R5;U4;L5"
1110 DATA"R5;D7"
1120 DATA"R5;D7;L5;U7;D3;R5"
1130 DATA"R5;D7;U4;L5;U3"
1140 REM DISPLAY DATE
1150 LINE(185,175)-(255,191),PRESET,BF
1160 MM=INT(12*(YR-INT(YR)))+1
1170 MM$=RIGHT$("00"+MID$(STR$(MM),2),2
)
1180 FORK=1TOLEN(MM$):C=VAL(MID$(MM$,K,
1))
1190 X1=195+(K-2)*8:Y1=180
1200 D$="BM"+STR$(X1)+","+STR$(Y1)+NM$(
C):DRAWD$:NEXTK
1210 YR$=MID$(STR$(INT(YR)),2)
1220 FORK=1TOLEN(YR$)
1230 C=VAL(MID$(YR$,K,1))
1240 X1=219+(K-2)*8:Y1=180
1250 D$="BM"+STR$(X1)+","+STR$(Y1)+NM$(
C)
1260 DRAW D$
1270 NEXTK
1280 RETURN
```

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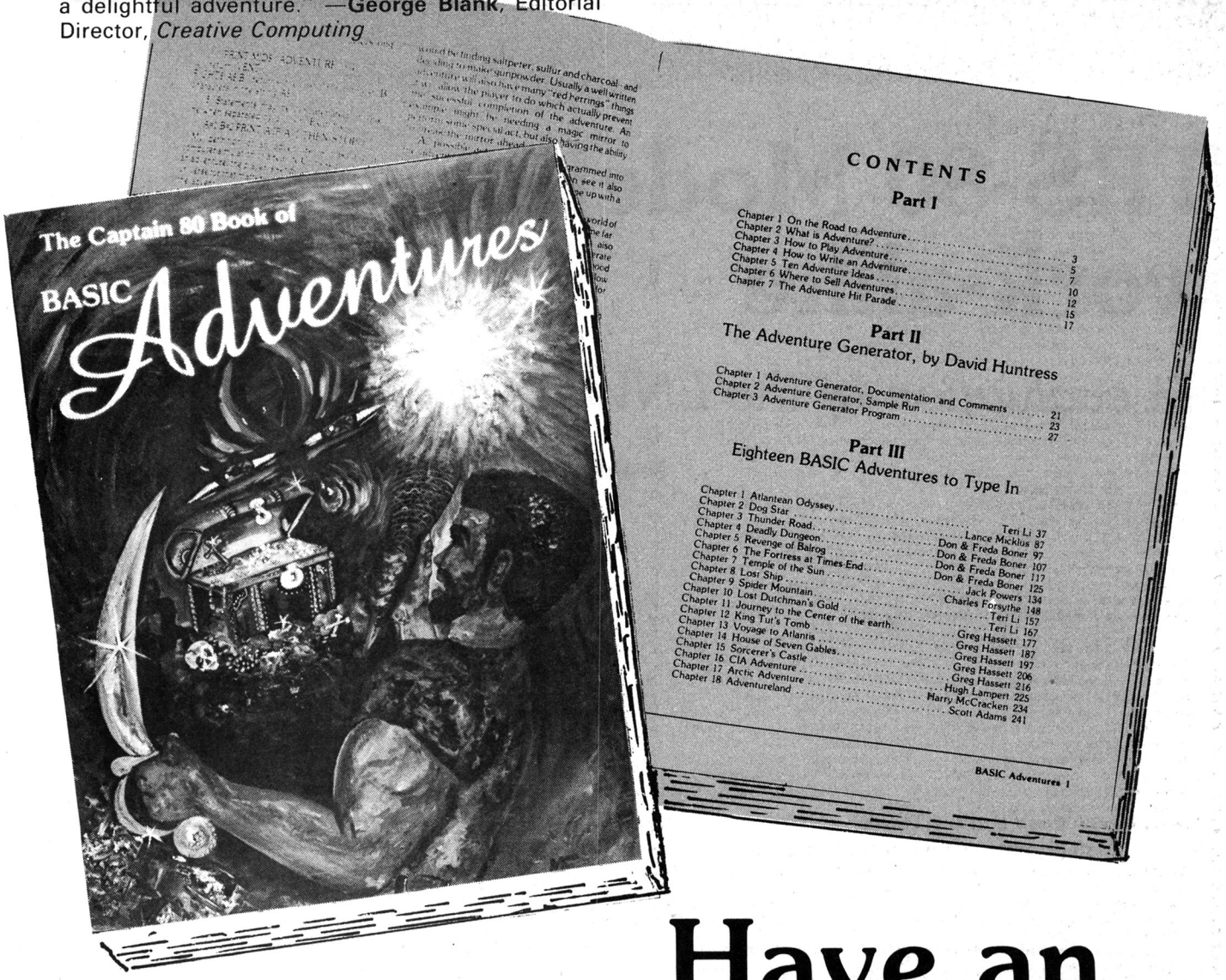


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# TRS-80 Model I work-alike

## *An evaluation of the LNW-80 microcomputer*

Frank Fischer and Eric Hilberg, Everett, WA

The Model T car and the TRS-80 Model I computer share one important concept. They were both developed as a simple, straightforward design with a minimum amount of frills and priced to appeal to the lower end of the market. Both enjoyed tremendous sales, but as the newness gave way under everyday use, limitations placed by the simple design began to make themselves apparent.

In the case of the TRS-80, these limitations showed themselves in slow processor speed, poor video resolution and no color capability. Other computers, with all of these features plus a higher price, soon appeared on the market. With sizeable investments in software and peripheral devices, many owners were reluctant to start all over again.

A middle-of-the-road solution in the form of the LNW-80 computer has now been on the market for over a year. Designed by LNW Research, of Costa Mesa, California (the same people who brought out the excellent expansion interface for use with the TRS-80 Model I), the computer might be considered the equal of a second generation TRS-80 Model I. Using a Z80-A processor capable of running at either 1.77 Mhz or 4 Mhz, it has all TRS-80 Model capabilities, plus high resolution black and white graphics (480 x 192), composite video color (128 x 192), Red-Green-Blue color (384 x 192), reverse video and upper-lower character set.

The LNW-80 computer can be obtained in various forms, from the bare circuit board and manual for $89.95, to the completed unit for $1450. The computer is designed in such a manner that the keyboard, Level 2 read-only-memory set and monitor from a TRS-80 Model I can be used. If you don't have these items, you can order them from LNW, as well as selected integrated circuits, power transformer and the case.

While the parts packing density is high, over 100 integrated circuit chips as well as on-board filtering and power regulation (all on a 10 x 16 inch circuit board), the layout appears to follow good engineering principles. The quality of the printed circuit traces as well as the solder mask and thru-hole plating is excellent. Mounting holes, edge connector and extra power supply capacity are provided to facilitate the addition of the expansion interface board with a minimum amount of fuss.

Assembly of the computer board is straightforward. Sockets for the integrated circuits (recommended by LNW as the traces and pads are small and therefore subject to damage by repeated soldering) are usually installed first, followed by the resistors, capacitors and other remaining parts. When all of the soldering is done, the rosin residue should be cleaned off and all solder joints given a careful examination. This is also a good time to verify the polarity of the diodes and capacitors.

Checking out the board begins with the power supply. Once this section is working properly, the jumpers, to bring power to the main part of the board, can be installed as well as the integrated circuits needed for the portion to be tested. The firmware used can be the Radio Shack Level II, two or three read-only-memory set, or the LNW six

read-only-memory set with P1 optioned to match the particular set used. With keyboard and monitor hooked up, application of power should show "MEMORY SIZE?" on the screen — if Mr. Murphy has not hexed you.

With the experience of five units to draw upon, performance has been the following: One unit powered up with no problems, three had problems in the area of wrong parts installed, faulty parts or bent integrated circuit pins, and one unit had a problem that required a call to LNW (they give excellent technical support). Black and white low resolution is standard TRS-80; the high resolution is very sharp. The composite video color, using a direct link to the monitor, works well but the radio frequency modulator, the color picture is rather marginal. The colors are not sharp and have "snow" in the background. One user installed an external radio frequency modulator which gave a little better picture. No one we know of has attempted to use the high resolution Red-Green-Blue color yet.

Although the documentation provided by LNW is brief, it is adequate. It can be augmented by the TRS-80 Level II technical manuals. While the schematics in the technical manual are different, the description of the logical operation of the various circuits is helpful.

The methods used (influenced in part by the skill and financial resources of the builder) in the construction of the computers were varied. In one case, a defunct 980 Adds terminal was cannibalized for its case, keyboard, monitor and power supply. Two persons chose to build their own cases. Small part procurement ranged from junk box to Digi-Key and JameCo. One unit was built from parts supplied almost entirely by LNW.

Building the LNW-80 computer has been a rewarding project, financially as well as emotionally. For a few hundred dollars, we have a system that is competitive with commercially-built systems costing over 2 thousand dollars. The pride associated with the statement, "I built it myself", does wonderful things for one's ego. ■

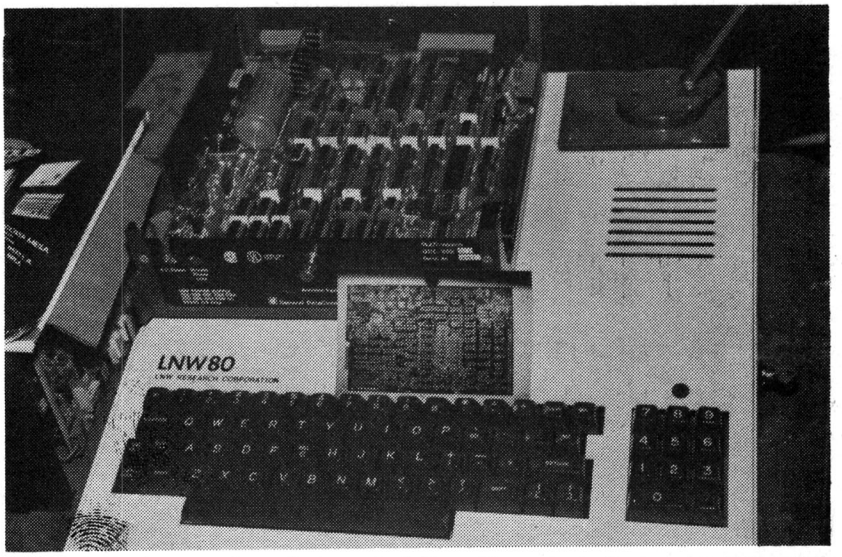



**Photo 1. A closeup view of photo 2, below. The case is that supplied by LNW Research Corporation. Photography by the authors.**

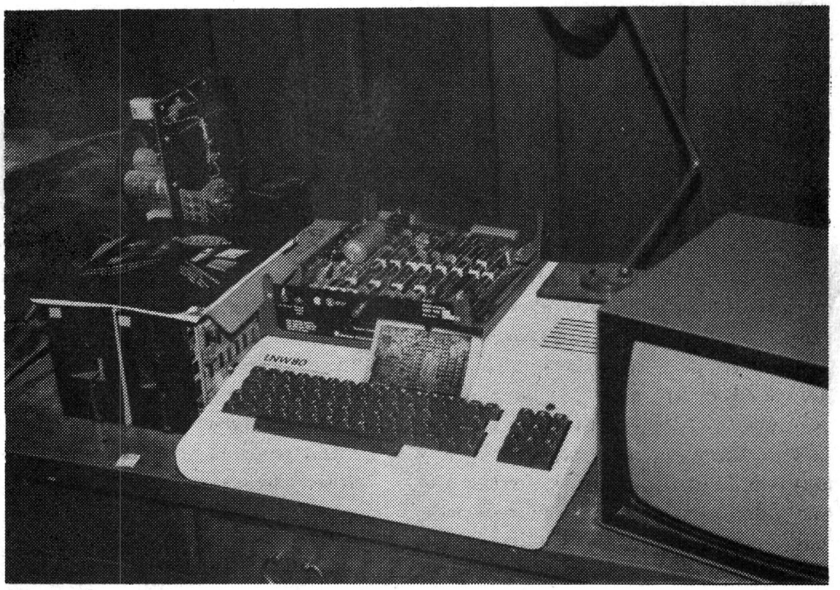
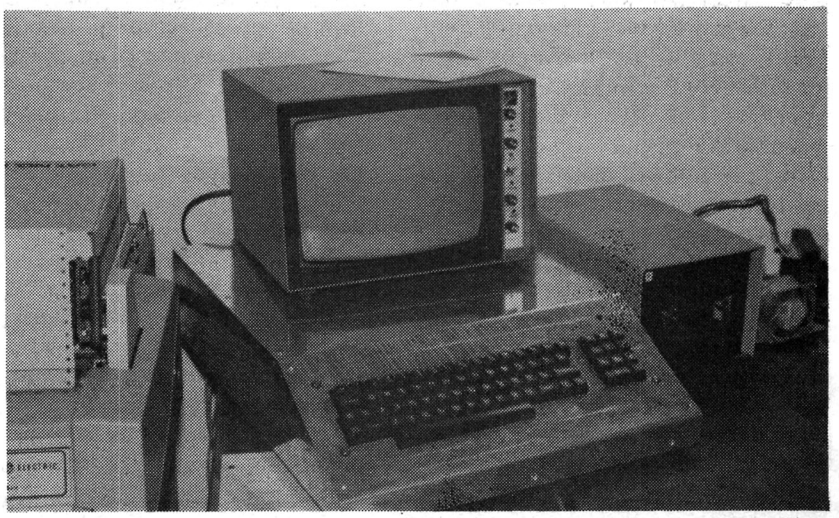


**Photo 2.**

**Photo 3. The LNW microcomputer in one of the author's homemade sheetmetal cases.**



# Add disk and memory to Model III

## *Do it yourself and save $$$*

**Model III**

Sal Navarro, East Rutherford, NJ

This article will tell you how to save approximately $600 when upgrading your Model III 16K computer to a 48K Model III with two disk drives. The task is accomplished in one hour with the use of an excellent set of instructions, a phillips screwdriver, a standard screwdriver and a pair of cutters.

After checking out the specifications of the different upgrade kits on the market, I chose the one advertised by B. T. Enterprises. This kit comes with a switching power supply manufactured by the same company that supplies the one in the Model III from Radio Shack. The only difference in this power supply is that it has a dual (120 volt/220 volt) voltage transformer on board. The quality of the disk controller board is equal to, or better than, that of Radio Shack's. The drive supports are made of high quality metal and the drives I purchased are Tandon. The memory chips are NEC, with 150 nanosecond switching time.

### The kit arrives

I ordered my 48K memory kit and disk controller with two drives from B. T. Enterprises, 171 Hawkins Road, Centereach, New York 11720 (516) 588-5836, for $849.95. By comparison, Radio Shack's kit was $1446.00 plus installation. The kit and instructions arrived in first class condition.

Upon reading the instructions, I found that they were geared to the novice. Anyone could install these parts with no problem that I could perceive. The disk controller comes from Micro Mainframes.

One thing I noted was that the edge connectors are gold plated. Anyone having previously owned a Model I will testify to having to "Pink Pearl" (use an eraser) a lot because of connections not being gold plated. Needless to say, I was impressed with what I saw, and was anxious to get everything installed.

### Installing 48K of memory

If you have 48K already, you can skip this section. If not, let's put in some memory.

The first thing you must do is to remove the AC power cord, then pick out a hard, flat surface to work on. I choose my desk because it is in a room without a carpet. Remember Murphy's Law about static charges and integrated circuits. Make sure your machine has been throughly checked out.

Now, lay down something soft on the work area as not to scratch the computer. Place the computer on the cloth, laying on its back. You will see nine screw holes. Remove the screws and remember which length screw came from where.

Now for the Forth Worth shudder: On the lower left corner is a label which, when broken, will void your 90-day warranty. Rub your finger over the label and feel for another screw hole. Push the screwdriver through and remove screw number 10. Turn the computer right side up and remove the screw in the top center area.

You are ready to remove the top cover and video tube. Remember when lifting the cover, that the end of the video tube comes very close to the rear circuit board. If you try to force anything, it will probably be damaged. Grab the cover and lift up and toward the left so that you can see under the case if anything starts to grab. Do not pull or tug because there will be two cables connected inside the cover after it is lifted off of the machine.

Lay the cover down on the left side and remove the two video connectors. Place the cover, with the video tube, where it cannot be damaged. Turn the unit around so that you are facing the rear of it. Remove the two screws on top of either side of the circuit cage. At the bottom, peel back the tape holding the foil to the bottom of the cage. Lift upward and outward on the top of the cage. Do the same on the sides, then lift off the cage cover. You can see now what you paid all of that money for.

In the top right corner of the circuit board, you will see three rows of chip sockets. The top row should be full with the original 16K you purchased. The second and third rows of sockets are where you will place the next 16K or 32K that you are going to install. If you have any doubts about Murphy and the static charge, ground yourself so as to

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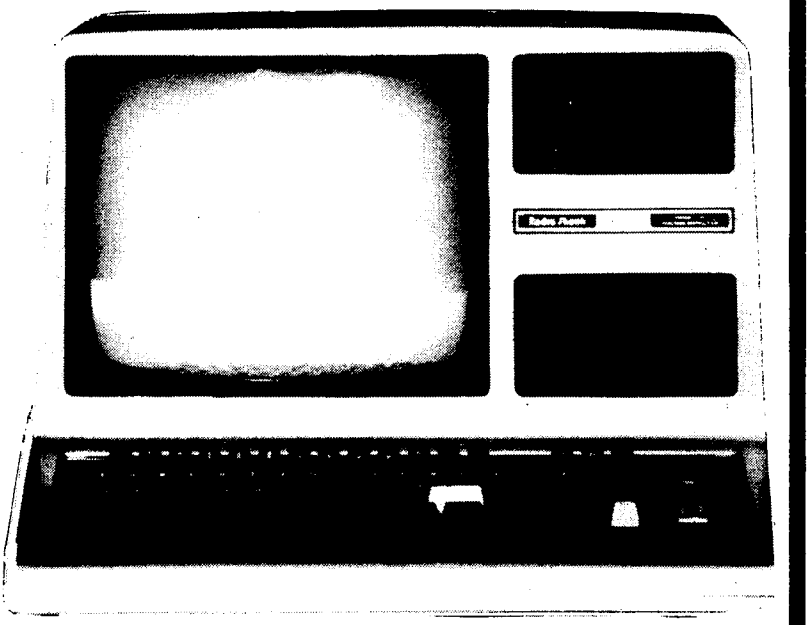

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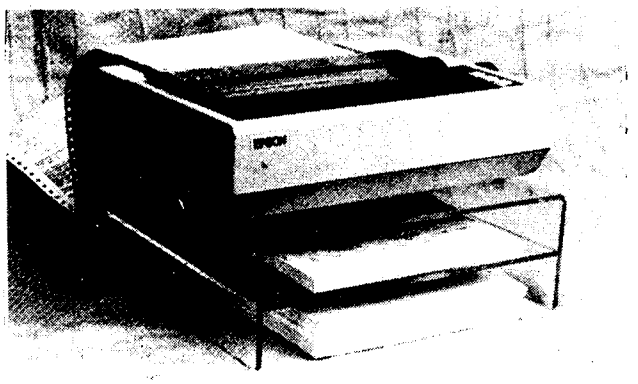

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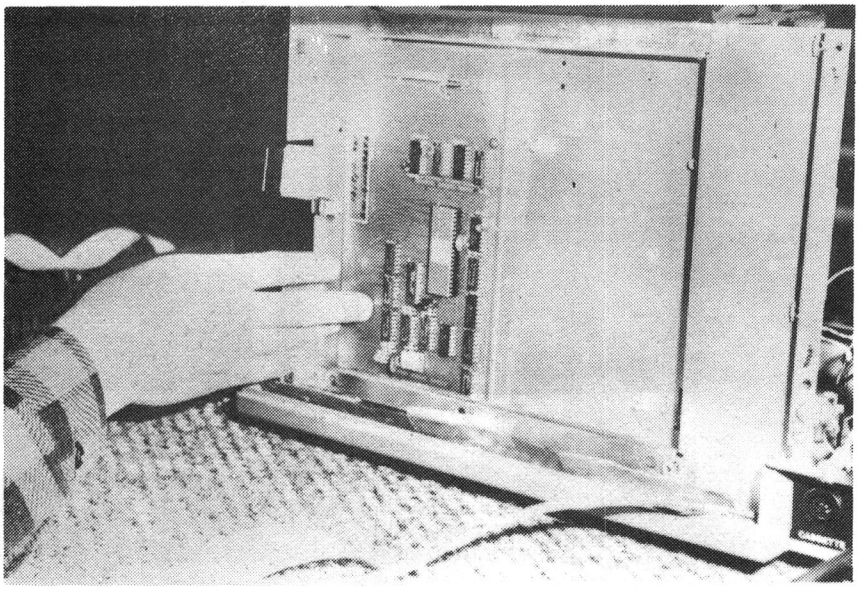

**Photo 1. The disk controller being put into place. Photographs in this article are by the author.**

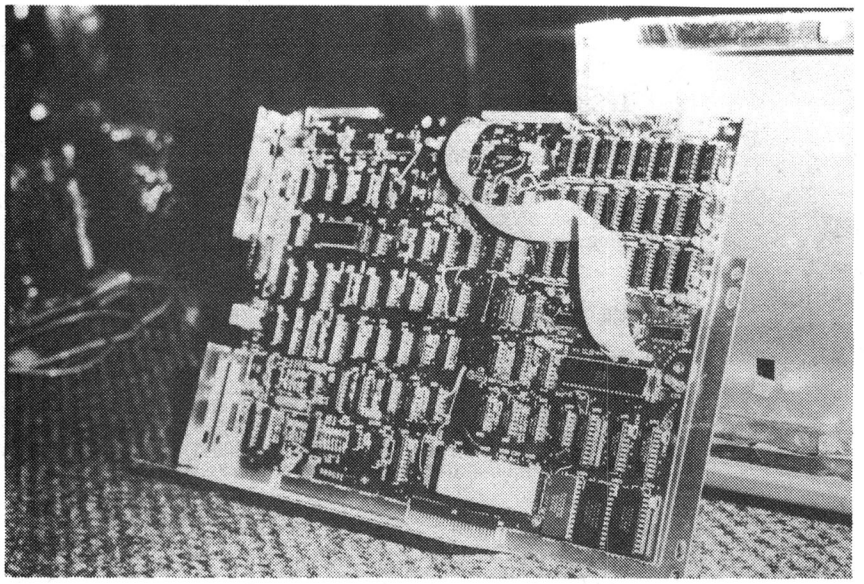

**Photo 2. Main board removed and with 48K of RAM installed.**

dissipate any charge you may have built up.

Be sure to insert the chips correctly. The notch is pointed up as the chip is installed in the socket. If you are only adding 16K at this time, make sure that they all go into the second row. If you already have 32K and are expanding to 48K, the chips will go into the third row.

Reverse the disassembly procedure, being sure to reinstall the two video connector cables to put the machine back together. After you are through with the reassembly, turn on the machine and press the ENTER key twice to get past CASS? and MEM SIZE. Now type "PRINT MEM". For a 32K machine, it should answer 31698 and a 48K machine should answer with 48082.

Now put back all the screws in the bottom and the one in the back. If you are going to install the disk modification now, you should have stopped after installing the chips.

### Installing the disk kit

Remove the main board and place it where it will not be damaged. Mount the disk controller board on the left side of the chasses on the metal standoffs using the 6/32 screws provided with the kit. Take the four-inch long ribbon cable and insert it into the connector at the top of the board. Replace the main board, taking care not to drop any of the rear insulators. Put back all the cables you removed before. You can double check yourself with the diagrams in the instruction sheets.

Turn your computer around and install the drive mount brackets in their noted positions using the supplied hardware and screws. Before I installed my drives, I installed the power supply connectors into the drives. This is a lot easier with the drives in front of you.

Place drive zero in the lowest position and secure it to the brackets. Install drive one in the upper position and secure it. Take the power supply and peel off the covering on the double-sided tape and secure it to the floor of the cabinet. Take the power supply cables from both drives and connect them to the power supply on positions SK2 and SK3. Locate the small white connector in the Tandy

cable harness and connect it to SK1 on the power supply board. Connect the free end of the 20-pin ribbon cable on the disk controller board to J7 (small white connector on the top left) of the main computer board. Make extra sure that both ends are tightly secured.

Connect the remaining 10-inch long flat ribbon cable from the small black connector just above the Z-80 to the one just like it below the white connector in the center of the board. Connect the drive cable to the drives with the red stripe of the cable to the left side of the drives. Double-check all of your connections, making sure that you haven't missed anything. Be certain, or Murphy will let you know.

### Almost finished

Now you have to remove the plastic disk drive dummy doors from the video cabinet. Take a pair of cutting pliers and snip the edges around the inner ring of the inserts. Be careful not to rush and take large cuts. Just snip each of the joints and it will fall out.

### Now you have drives

Place the cover next to the computer base and reconnect the video plugs. Gently and carefully place the cover back on the computer, being careful with the rear of the tube. Power up the computer and it will respond with "Diskette?". Now take your operating system and insert it into the bottom drive and press the RESET button. It should sign on and be ready to run. If not, recheck all of the steps you have done.

There is a "When things go wrong" list included with the instruction sheets which lists most of the problems that have occured in the past. The only problem that I ran into was that the power supply cable to drive zero had a loose wire in it. Beyond that, it went together in under one hour.

The instructions are simple to follow and easy to read. I have used this system for two months now, and it has not missed a bit. If you are planning to upgrade your system to disks, I highly recommend the Micro Mainframes disk controller and power supply from B. T. Enterprises ■

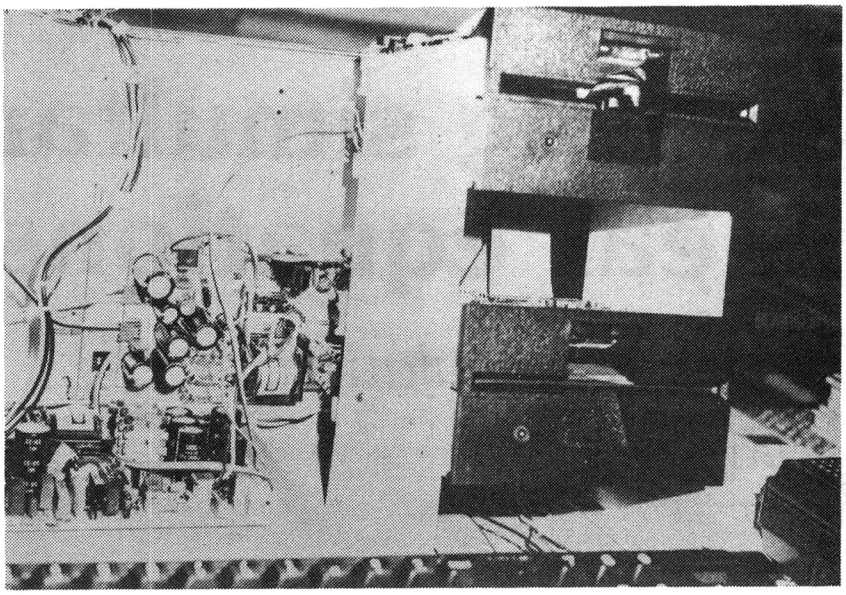

**Photo 3. Shows power supply, disk drive brackets and drives installed.**

**Photo 4. Shows the Model III with 48K and two drives being run with LDOS.**

# Solving simultaneous linear equations

## *Matrix manipulation*

**Model I, II and III**

J. C. Adams, Jr., Ph.D., Tullahoma, TN

The solution of sets of simultaneous linear algebraic equations consumes a significant fraction of the computer time at virtually all general purpose computer service centers. The solution of such sets arises in a wide variety of problems, including the numerical solution of ordinary and partial differential equations, structural analysis, network analysis, optimization, data analysis, and curve fitting. Sets composed of large numbers of equations are commonly encountered, and the choice of a suitable technique for a given problem which is both accurate and efficient is of prime concern. This article will present one such method applicable for solution of sets of simultaneous linear algebraic equations using the Radio Shack TRS-80 Model I microcomputer system with Level II BASIC.

### BASIC Matrix Terminology

A matrix is defined in this context as a rectangular array of numbers, with its size characterized by the number of rows and columns in the array. Thus:

$$A = \begin{bmatrix} 1 & 7 & -1 & 4 & 8 & 7 & 3 & 1 \\ 2 & -4 & 7 & 0 & 1 & 9 & 9 & 6 \\ 1 & -1 & 0 & 5 & 3 & 7 & 2 & -1 \\ 4 & 4 & 9 & 8 & -2 & -8 & 3 & 0 \\ 3 & 6 & 2 & -7 & 5 & 8 & 0 & 5 \end{bmatrix}$$

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is a five (row) by eight (column) matrix. Any given element of the matrix A will be denoted by A(I,J), where I is the row location and J is the column location. Thus, A(3,4) = 5. Our concern for this article will be with square matrices (number of rows = number of columns) and column vectors of the form:

$$B = \begin{bmatrix} 4 \\ -2 \\ 5 \\ 9 \\ 1 \end{bmatrix}$$

which is denoted as B(J), where J is the column location. Thus, B(3) = 5.

Consider a set of simultaneous linear algebraic equations (we arbitrarily choose three equations in three unknowns for illustrative purposes). This set can be written as:

$$\begin{aligned} A(1,1)\,X(1) + A(1,2)\,X(2) + A(1,3)\,X(3) &= B(1) \\ A(2,1)\,X(1) + A(2,2)\,X(2) + A(2,3)\,X(3) &= B(2) \\ A(3,1)\,X(1) + A(3,2)\,X(2) + A(3,3)\,X(3) &= B(3) \end{aligned}$$

An equivalent representation in matrix form is:

$$\begin{bmatrix} A(1,1) & A(1,2) & A(1,3) \\ A(2,1) & A(2,2) & A(2,3) \\ A(3,1) & A(3,2) & A(3,3) \end{bmatrix} \begin{bmatrix} X(1) \\ X(2) \\ X(3) \end{bmatrix} = \begin{bmatrix} B(1) \\ B(2) \\ B(3) \end{bmatrix}$$

or, A X = B, where A is the square matrix of coefficients, X is the column vector of unknowns, and B is the column

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vector of the right hand sides. A numerical example in matrix format is as follows:

$$\begin{bmatrix} 3 & 1 & -1 \\ 1 & 4 & 1 \\ 2 & 1 & 2 \end{bmatrix} \begin{bmatrix} X(1) \\ X(2) \\ X(3) \end{bmatrix} = \begin{bmatrix} 2 \\ 12 \\ 10 \end{bmatrix}$$

which has the exact solution:

$$X = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

or X(1) = 1, X(2) = 2, and X(3) = 3.

### Numerical Solution Algorithm

One of the most commonly employed direct methods for the numerical solution of sets of simultaneous linear algebraic equations is the so-called Gaussian elimination described in complete detail by most numerical analysis textbooks (see Bibliography). One computational difficulty can arise with the standard Gaussian elimination technique. The pivot element in each row is the element on the main diagonal of the matrix. Under certain circumstances, the diagonal element can become very small in magnitude compared to the rest of the elements in the pivot row, as well as perhaps being quite inaccurate. For various reasons, this can create a very unfavorable situation in terms of roundoff error which can result in an inaccurate solution vector.

This type of roundoff error problem can be particularly significant with large sets of equations. The problem can be effectively treated by interchanging rows in the matrix (and in the right hand side) to bring the largest element in the column to the pivot position. Strategies to maximize pivot elements are sometimes called "positioning for size" or "pivoting."

Almost all large-scale modern computing installations performing scientific/engineering calculations have "stock" subroutines for solving sets of simultaneous linear algebraic equations. These are usually based on variants of Gaussian elimination, employing pivoting.

One of the most readily available, best documented, efficient, and of proven accuracy, "stock" subroutines, is contained in the IBM Scientific Subroutine Package (see Bibliography). This subroutine, called SIMQ, is written in FORTRAN for use on IBM System 360 computers. A Level II BASIC version of subroutine SIMQ is presented in the associated listing.

Complete documentation of this subroutine is provided via comments by REM statements. Also provided is a cross reference listing of all subroutine variables, BASIC statements, and BASIC functions by line number. It is important to note that the coefficients of matrix A must be stored columnwise in vector format for use in subroutine SIMQ.

### Application of Subroutine SIMQ

In order to apply subroutine SIMQ for numerical solution of sets of simultaneous linear algebraic equations of the form AX=B, a controlling or executive program must be written to input the A-matrix and the B-vector as well as to output the X-solution vector. Provisions must be included to report the possibility of a singular matrix (if matrix A is singular, no unique solution exists) as determined by subroutine SIMQ via the KS (output digit) variable.

One fairly general controlling, or executive, program, is given in the listing, again written in Level II BASIC. Note that all variables beginning with an I through N are declared to be integer variables (the DEFINT I-N statement). All variables beginning with an A through H or O through Z are declared to be double precision variables (the DEFDBL A-H, O-Z statement).

As discussed in the last section, the primary difficulty in the numerical solution technique is roundoff error. The best defense for this is a large word size (many decimal digits), hence double precision arithmetic. Further note that the A-matrix and B-vector coefficients are input as string variables and converted to double precision numerical quantities through the VAL function; this is per the discussion on page 4/22 of the Second Edition of the Level II BASIC Reference Manual.

The A-matrix is stored columnwise in vector format as required for use in subroutine SIMQ. Dimensions for both the A-matrix and B-vector are set in line 50 based upon the input value N for the number of equations to be solved. The solution vector X is returned as the B-vector from subroutine SIMQ. If matrix A is singular, subroutine SIMQ returns a value of KS equal to unity (1), which is acknowledged at line 160 and accompanied by a STOP statement.

Some illustrative problems for solution using subroutine SIMQ follow. The reader is urged to work these problems using his/her version of subroutine SIMQ in order to ascertain that the subroutine has been correctly typed from the article listing. Needless to say, all comments denoted by REM statements in subroutine SIMQ (with the exception of line 10000) could be deleted if additional free memory needed to be made available. All blank spaces in subroutine SIMQ should also be eliminated in a production version where speed of execution is a primary factor.

### Example Problem 1

Solve:

$$1.01\ X(1) + 0.99\ X(2) = 2$$
$$0.99\ X(1) + 1.01\ X(2) = -2$$

which has the exact solution X(1) = 100.0 andX(2) = -100.0 with the SIMQ-computed input/output shown in the example problem listing.

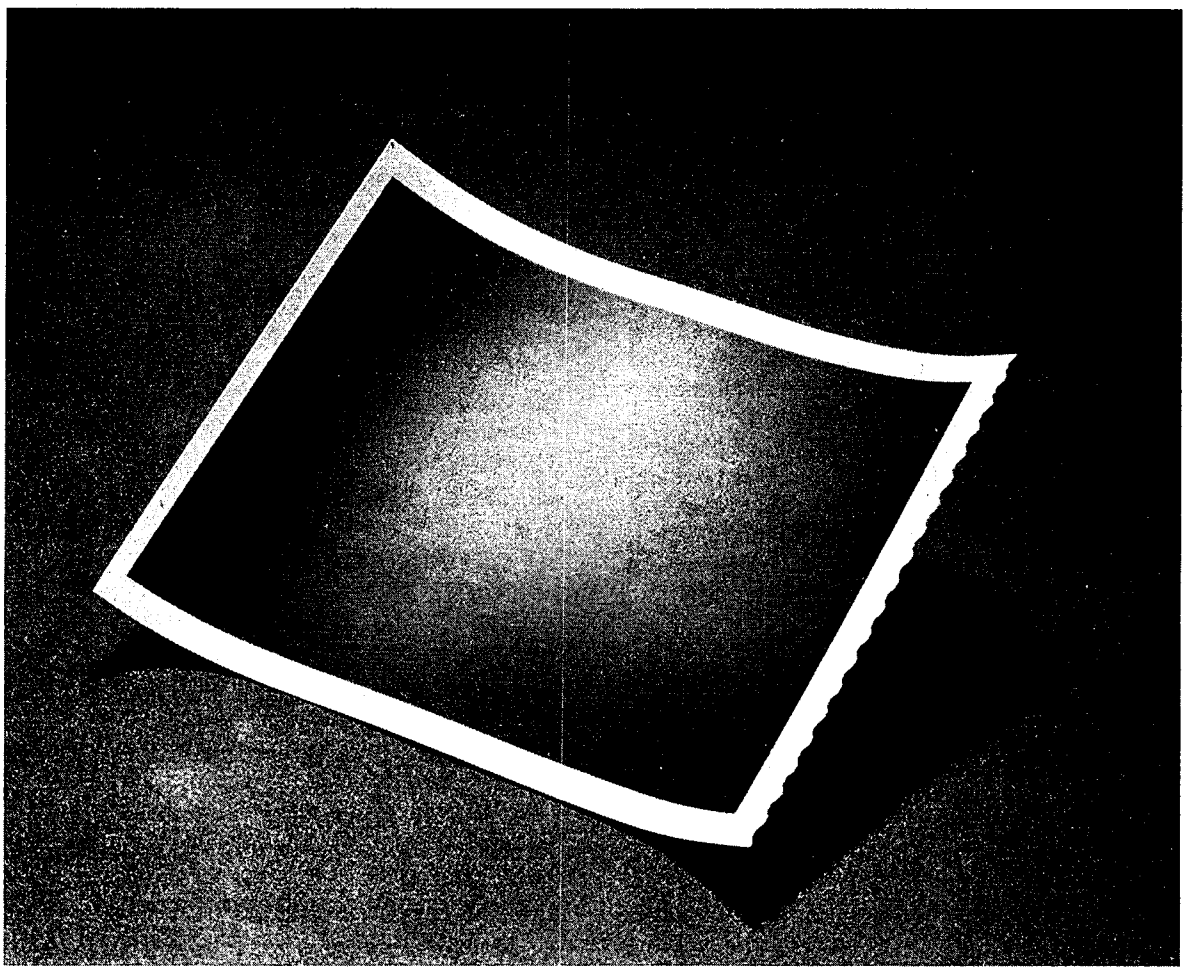
### Example Problem 2

Solve:

$$0.24\ X(1) + 0.36\ X(2) + 0.12\ X(3) = 0.84$$
$$0.12\ X(1) + 0.16\ X(2) + 0.24\ X(3) = 0.52$$
$$0.15\ X(1) + 0.21\ X(2) + 0.25\ X(3) = 0.64$$

which has the exact solution X(1) = -3.0, X(2) = 4.0, and X(3) = 1.0 with the SIMQ-computed solution:

X(1) = -3.00000000000001
X(2) = 4.000000000000006
X(3) = 1.000000000000001



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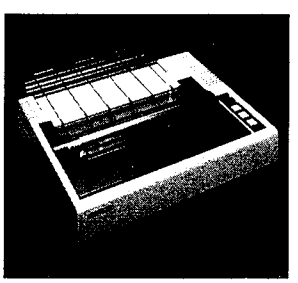

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### Example Problem 3

Solve:

$$4\,X(1) + 3\,X(2) - 1\,X(3) = 6$$
$$7\,X(1) - 2\,X(2) + 3\,X(3) = 9$$
$$5\,X(1) - 18\,X(2) + 13\,X(3) = 3$$

which has no unique solution, i.e., the A-matrix is singular. The present problem was contrived by forming the third equation as a linear combination of the first two equations. In practice, it is quite common in certain physical problems to accidentally form a singular set of equations by applying a physical principle which is not independent of the other physical principles used to construct the set. This singular character of the set can sometimes be difficult to detect, particularly if the results of the solution happen to be physically reasonable. Remember Murphy's Law!

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Forsythe, George E., Malcolm, Michael A., and Moler, Cleve B. *Computer Methods For Mathematical Computations.* Prentice-Hall, Inc., Englewood Cliffs, N.J., 1977.

Gerald, Curtis F. *Applied Numerical Analysis.* Addison-Wesley Publishing Company, Inc., Reading, Massachusetts, 1970.

Hornbeck, Robert W. *Numerical Methods.* Quantum Publishers, Inc., New York, 1975.

IBM System/360 Scientific Subroutine Package Programmer's Manual (360A-CM-03X), 1966.

### Example Problem 1—Input/Output

### Simultaneous Linear Equations

```
Input number of equations? 2

Input A-matrix coefficients and B-vector constants
Equation 1
  Coefficient 1 => A ( 1 , 1 ) ? 1.01
  Coefficient 2 => A ( 1 , 2 ) ? 0.99
  Constant => B ( 1 ) ? 2.0
Equation 2
  Coefficient 1 => A ( 2 , 1 ) ? 0.99
  Coefficient 2 => A ( 2 , 2 ) ? 1.01
  Constant => B ( 2 ) ? -2.0

Solution of simultaneous linear equations in progress

Numerical solution
X ( 1 ) =  99.99999999999991
X ( 2 ) = -99.99999999999991

End of job
```

### Listing 1
### Solving Simultaneous Linear Equations

```
10 CLS : PRINT "S I M U L T A N E O U S
      L I N E A R     E Q U A T I O N
  S"
20 CLEAR 50 : DEFINT I-N : DEFDBL A-H,
  O-Z
30 PRINT
40 INPUT "INPUT NUMBER OF EQUATIONS ";
  N
50 DIM A(N*N), B(N)
60 PRINT : PRINT "INPUT A-MATRIX COEFFI
  CIENTS AND B-VECTOR CONSTANTS"
70 FOR I = 1 TO N
80 PRINT "EQUATION"; I : K = I
90 FOR J = 1 TO N
100 PRINT "  COEFFICIENT"; J; "=> A (";
   I; "," J; ") "; :
    INPUT A$ : A(K) = VAL(A$) : K = K +
   N
110 NEXT J
120 PRINT "  CONSTANT => B ("; I; ") ";
   : INPUT B$ :
    B(I) = VAL(B$)
130 NEXT I
140 PRINT : PRINT "SOLUTION OF SIMULTAN
  EOUS LINEAR EQUATIONS IN PROGRESS"
150 GOSUB 10000 : REM  CALL SIMQ( A, B,
   N, KS )
160 IF KS = 1 THEN PRINT : PRINT "*****
     S I N G U L A R     M A T R I X
   *****" : PRINT : STOP
170 PRINT : PRINT "NUMERICAL SOLUTION"
180 FOR I = 1 TO N
190 PRINT "X ("; I; ") = "; B(I)
200 NEXT I
210 PRINT : PRINT "E N D     O F     J O
  B" : PRINT
220 END
10000 REM SUBROUTINE SIMQ( A, B, N, KS
  )
10010 REM FORWARD SOLUTION
10020 TL = 0 : KS = 0 : JJ = -N
10030 FOR J = 1 TO N : JY = J + 1 : JJ
  = JJ + N + 1 : BA = 0 :
      IT = JJ - J
10040 REM SEARCH FOR MAXIMUM COEFFICIEN
  T IN COLUMN
10050 FOR I = J TO N : IJ = IT + I
10060 IF ABS(BA) - ABS(A(IJ)) >= 0 THEN
   NEXT I
      ELSE BA = A(IJ) : RB = 1/BA : IM
  = I : NEXT I
```

```
10070 REM TEST FOR PIVOT LESS THAN TOLE
  RANCE (SINGULAR MATRIX)
10080 IF ABS(BA) - TL > 0 THEN 10100 EL
  SE KS = 1 : RETURN
10090 REM INTERCHANGE ROWS IF NECESSARY
   AND
         DIVIDE EQUATION BY LEADING CO
  EFFICIENT
10100 I1 = J + N*(J-2) : IT = IM - J
10110 FOR K = J TO N : I1 = I1 + N : I2
   = I1 + IT : SE = A(I1) :      A(I1)
  = A(I2) : A(I2) = SE : A(I1) = A(I1)*
  RB : NEXT K
10120 SE = B(IM) : B(IM) = B(J) : B(J)
  = SE*RB
10130 REM ELIMINATE NEXT VARIABLE
10140 IF J = N THEN 10190 ELSE IQ = N*(
  J-1)
10150 FOR IX = JY TO N : IZ = IQ + IX :
   IT = J - IX
10160 FOR JX = JY TO N : IA = N*(JX-1)
  + IX : JC = IA + IT :
      A(IA) = A(IA) - A(IZ)*A(JC) : NEX
  T JX
10170 B(IX) = B(IX) - B(J)*A(IZ) : NEXT
   IX, J
10180 REM BACK SOLUTION
10190 NY = N - 1 : IT = N*N
10200 FOR J = 1 TO NY : IA = IT - J : I
  B = N - J : IC = N
10210 FOR K = 1 TO J : B(IB) = B(IB) -
  A(IA)*B(IC) :
      IA = IA - N : IC = IC - 1 : NEXT
  K, J
10220 RETURN
```

**Listing 2**
**Solving Simultaneous Linear Equations**
**Same as subroutine in Listing 1, but fully remarked from Line 10000 on.**

```
10000 REM SUBROUTINE SIMQ( A, B, N, KS
  )
10010 REM
10020 REM PURPOSE:
10030 REM     OBTAIN NUMERICAL SOLUTION
  OF A SET OF SIMULTANEOUS
10040 REM     LINEAR ALGEBRAIC EQUATIONS
   OF THE FORM  AX = B.
10050 REM USAGE:
10060 REM     GOSUB 10000
10070 REM DESCRIPTION OF PARAMETERS:
10080 REM     A  =  MATRIX OF COEFFICIEN
  TS STORED COLUMNWISE IN
10090 REM           VECTOR FORMAT.  THES
  E ARE DESTROYED IN THE
```


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```
10100 REM            COMPUTATION.  THE SI
  ZE OF MATRIX A IS N X N.
10110 REM     B  =   VECTOR OF ORIGINAL C
  ONSTANTS (LENGTH N)
10120 REM            WHICH ARE REPLACED B
  Y FINAL SOLUTION
10130 REM            VALUES, VECTOR X.
10140 REM     N  =   NUMBER OF EQUATIONS
  AND VARIABLES.
10150 REM     KS =   OUTPUT DIGIT.
10160 REM            0 FOR A NORMAL SOLUT
  ION.
10170 REM            1 FOR A SINGULAR SET
   OF EQUATIONS.
10180 REM REMARKS:
10190 REM     MATRIX A MUST BE SQUARE OF
   DIMENSION N X N.
10200 REM     VECTOR B MUST HAVE LENGTH
  N.  IF MATRIX A IS
10210 REM     SINGULAR, SOLUTION VALUES
  ARE MEANINGLESS.
10220 REM METHOD:
10230 REM     THE METHOD OF SOLUTION IS
  BY ELIMINATION USING
10240 REM     THE LARGEST PIVOTAL DIVISO
  R.  EACH STAGE OF
10250 REM     ELIMINATION CONSISTS OF IN
  TERCHANGING ROWS
10260 REM     WHEN NECESSARY TO AVOID DI
  VISION BY ZERO OR
10270 REM     SMALL ELEMENTS.  THE FORWA
  RD SOLUTION TO
10280 REM     OBTAIN VARIABLE N IS DONE
  IN N STAGES.  THE
10290 REM     BACK SOLUTION FOR THE OTHE
  R VARIABLES IS
10300 REM     CALCULATED BY SUCCESSIVE S
  UBSTITUTIONS.
10310 REM     FINAL SOLUTION VALUES ARE
  DEVELOPED IN VECTOR
10320 REM     B, WITH VARIABLE 1 IN B(1)
  , VARIABLE 2 IN B(2),
10330 REM     ......, VARIABLE N IN B(N)
  .  IF NO PIVOT CAN
10340 REM     BE FOUND EXCEEDING A TOLER
  ANCE OF 0.0, THE
10350 REM     MATRIX IS CONSIDERED SINGU
  LAR AND KS IS SET
10360 REM     EQUAL TO 1.  THIS TOLERANC
  E CAN BE MODIFIED
10370 REM     BY REPLACING THE STATEMENT
   FOR TL IN LINE 10410.
10380 REM
10390 REM FORWARD SOLUTION
10400 REM
10410 TL = 0 : KS = 0 : JJ = -N
10420 FOR J = 1 TO N : JY = J + 1 : JJ
  = JJ + N + 1 : BA = 0 :
      IT = JJ - J
10430 REM
10440 REM SEARCH FOR MAXIMUM COEFFICIEN
  T IN COLUMN
10450 REM
10460 FOR I = J TO N : IJ = IT + I
10470 IF ABS(BA) - ABS(A(IJ)) >= 0 THEN
   NEXT I
      ELSE BA = A(IJ) : RB = 1/BA : IM
  = I : NEXT I
10480 REM
10490 REM TEST FOR PIVOT LESS THAN TOLE
  RANCE (SINGULAR A-MATRIX)
10500 REM
10510 IF ABS(BA) - TL > 0 THEN 10550 EL
  SE KS = 1 : GOTO 10740
10520 REM
10530 REM INTERCHANGE ROWS IF NECESSARY
   AND
         DIVIDE EQUATION BY LEADING CO
  EFFICIENT
10540 REM
10550 I1 = J + N*(J-2) : IT = IM - J
10560 FOR K = J TO N : I1 = I1 + N : I2
   = I1 + IT : SE = A(I1) :      A(I1)
  = A(I2) : A(I2) = SE : A(I1) = A(I1)*
  RB : NEXT K
10570 SE = B(IM) : B(IM) = B(J) : B(J)
  = SE*RB
10580 REM
10590 REM ELIMINATE NEXT VARIABLE
10600 REM
10610 IF J = N THEN 10680 ELSE IQ = N*(
  J-1)
10620 FOR IX = JY TO N : IZ = IQ + IX :
   IT = J - IX
10630 FOR JX = JY TO N : IA = N*(JX-1)
  + IX : JC = IA + IT :
      A(IA) = A(IA) - A(IZ)*A(JC) : NEX
  T JX
10640 B(IX) = B(IX) - B(J)*A(IZ) : NEXT
   IX : NEXT J
10650 REM
10660 REM BACK SOLUTION
10670 REM
10680 NY = N - 1 : IT = N*N
10690 FOR J = 1 TO NY : IA = IT - J : I
  B = N - J : IC = N
10700 FOR K = 1 TO J : B(IB) = B(IB) -
  A(IA)*B(IC) :
      IA = IA - N : IC = IC - 1 : NEXT
  K : NEXT J
10710 REM
10720 REM RETURN TO CALLING PROGRAM
10730 REM
10740 RETURN
```

# YOUR Family Tree

By Chuck Acree

NEW!

A comprehensive genealogical program that lets you avoid the rigidities of paper-based family trees. It quickly and easily sets up a data base to hold pertinent information about each ancestor, including name, date and place of birth, marriage and death information, plus a comment line.

YOUR FAMILY TREE will display and print a complete "pedigree" for any selected family member; or a 3-generation ancestral chart may be generated for display or printer, showing the number of known ancestors beyond each branch of the tree. As a novelty feature, the program will display a U.S. outline map showing migration across the country. Access to information in YOUR FAMILY TREE is virtually unlimited, with full search capabilities on any key field—using full or partial information.

16K RAM has space for 45-55 ancestors with brief comments. A 32K cassette-based system will hold about 175 records; a 48K, about 300. In all cases, a disk-based system will hold about 75 less due to DOS overheard.

Available for TRS-80* models I and III on tape or disk, YOUR FAMILY TREE requires a minimum of 16K RAM. Enjoy the benefits of this powerful and flexible charting system now for just $29.95.

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**By Andrew P. Bartorillo**

A complete management tool for the home budget, it accurately keeps track of your checkbook and provides an easy method of budget allocation.

You can store information on up to 100 checkbook entries per month (250 with 48K), specify any automatic withdrawals, keep records of tax-deductibles, and record expenses by category. You can even break up charge account payments into the proper categories.

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**By David Feitelberg**

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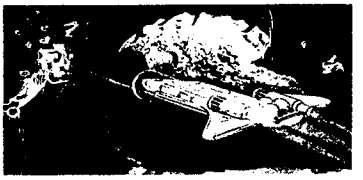

## SPACE ROCKS

**By Steven Kearns**

Huge antimatter rocks appear on the Tactical Display Screen of your spacecraft. You blast away but they just explode into smaller chunks for you to destroy. To add to your woes, alien ships and time bombs appear periodically. If the ships hit you or the timers reach zero—BOOM! Maneuver, fire lasers, jump to hyperspace—anything to avoid the onslaught. For one or two players, with nine skill levels.

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# Small business invoice program

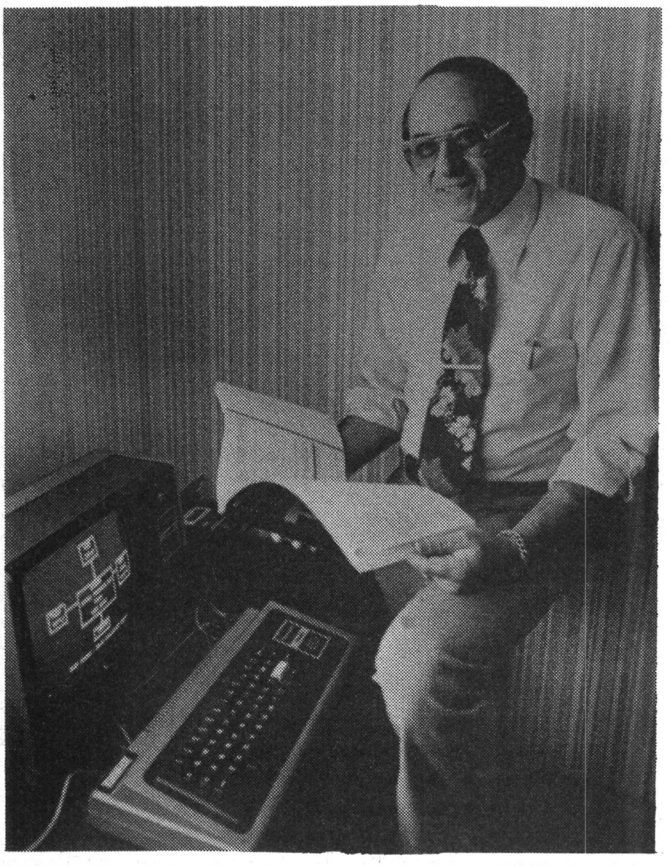
## *Generates an invoice and label*

**Model I/III and Color Computer with 16K extended BASIC**

**Fred Blechman, Canoga Park, CA**

If you operate a business, you use an invoice of some sort. You may call it an order form, purchase order, bill, sales receipt, sales ticket, job order or something else. If you regularly sell ten different items or less, this program will print and total your invoice, showing each purchase as well as special items and remarks. It will indicate the amount of any overpayment or amount due and will also print out address labels.

**The author, Fred Blechman.**



### The Need Arises

When I started a small mail order business selling software for the Radio Shack TRS-80 a few years ago, I used a small, two-part carbon sales book—the kind you get for about 30 cents at a five-and-dime or stationary store. It looked Mickey Mouse and was! As the business grew and I offered more items for sale, the invoice got more complicated.

When business income made a custom invoice affordable, I had a local print shop run invoice forms with my company name, address and phone number. I still wrote out each invoice and shipping label until one day it dawned on me . . . Here I was selling computer programs and not using the computer for a job it could easily do. So, I wrote the Small Business Invoice Program.

### Not for Everyone

If you're conversant in BASIC, you can see from the program listing how simple and unsophisticated it is. For that reason, it has some practical limitations. Of course, you must have a printer, since the purpose of the program is to generate an invoice and address labels. However, if you sell more than ten different items, this program won't do the job without several changes beyond the scope of this article.

As written, the program is intended for use with carbon paper or NCR forms since it prints out in *real time* and the information is *not* stored for additional copies or historical records. These compromises in capability greatly simplify the program but will not satisfy all needs, even though they satisfy mine.

My printer is an Okidata Microline 80 which handles

up to three thicknesses of paper as well as roll and pin feed paper. If your printer does not handle more than one thickness of paper, you can't use this program properly. this program is designed for a 4½" wide form. If your printer does not have condensed characters, you can use an 8½" wide invoice form. If your printer only has tractor or pin feed, you'll have to tape the invoice to the top of your regular paper and have it carry the invoice through the printer. Of course, you can also buy pre-printed tractor fed invoice forms—but if you're *that* big a spender, you'll probably want something more elaborate than this "plain vanilla" invoice program.

Look at the sample run and use the program as it is a few times to become familiar with the prompts, screen display and printout. The text, item descriptions and prices are, of course, the ones I use. You must customize the program for your own use.

### Customizing

Enter the description and price of each item you sell on a separate DATA line, starting at line 1000. Looking at lines 1000-1030 in the lasting as examples, notice that each line contains a short description followed by a comma and then the unit price. Do not enter more than ten items since the program will ignore any beyond ten. Do not omit line 1200 as it is needed when you have less than ten items.

Next, correct lines 240-330 to reflect your own DATA. Each DATA item is entered into arrays A$(X) and P(X) by lines 210-330. The first DATA item is A$(1), with a price of P(1) and goes to A$(5) in line 285 since I have five items for sale. If you have more than four items, add them between lines 280 and 290. If you have more or less than five DATA items, renumber the (6) and (7) in lines 290, 300, 310, 320, 330, 420 and 430.

Change the text in lines 20-50 to provide instructions for proper alignment of your own invoice form and put your name, instead of mine, in line 810. The sales tax is calculated and printed by program line 530 as 6 percent of the total (T=.06*TT). If necessary, change this and "6% CA SALES TAX" later in line 530.

This all sounds like a lot of work. It isn't. The changes are pretty obvious once you get the hang of the program and they are easier to do than to describe. Once you customize the program to your own needs, you can make copies for everyday use without making any changes.

### Using the Program

Using the program is very easy. Load the customized program into your TRS-80, type and enter RUN. Insert your invoice form in the printer and make sure it's ready to print. Now, using the keyboard, follow the screen prompts to enter the date, customer name and address. Three address lines are available. If you don't need the last one, just press ENTER. This information will print out on the invoice one line at a time as it's entered. If you start a line with a quotation mark, you can use any punctuation on that line except another quotation mark.

Once you've completed the customer information, the screen will show a menu of items that can be ordered by number. Just type and ENTER the menu number and the screen will confirm the choice and ask you the quantity. Type and Enter the quantity. That item, with the *extended* price, will be printed on your invoice (but *not* on the screen). The computer memory keeps track of total cost.

Notice my menu item (6) is Special Order Item which can be used to type in *anything* for that line. I use this for special items not in DATA or quantity discounts. Enter the description, price each (using a minus number for discount, refund, rebate or other negative amount) and quantity.

When all items have been entered, Type and Enter the menu number for End of Order. Answer Y or N to the sales tax question. If you select N, the sales tax will be ignored by the printer.

You have the opportunity to enter a shipping and handling charge, after which a grand total is printed. The program calculates whether the payment was correct, over or under, and prints the appropriate message and amount.

If you have any remarks, such as specifying separate ships, back orders, price change or a personal message, the program will print one line at a time until you

**Sample Run**

**Blechman Enterprises**

7217 BERNADINE AVE.
CANOGA PARK, CALIFORNIA 91307
PHONE (AREA 213) 346-7024

5/23/81 PHONE:(213)999-8888

JOE DOAKS
123 4th ST.
ANYTOWN CA 91399

| | | |
|---|---|---|
| 1 | AMWAY PRODUCT DISTRIBUTOR PROGRAMS | 30.00 |
| 1 | SMALL HOME-BUSINESS PROGRAMS | 25.00 |
| 1 | ''PROGRAMS FOR BEGINNERS.....'' BOOK | 8.95 |
| 1 | ''PROGRAMS FOR BEGINNERS.....'' CASSETTE | 10.95 |
| | TOTAL..... | 74.90 |
| | 6% CA SALES TAX..... | 4.49 |
| | SHIPPING/HANDLING..... | 0.00 |
| | GRAND TOTAL..... | 79.39 |

PAID CHECK # 123 $ 74.9 AMOUNT DUE: $ 4.49 . PLEASE REMIT.
BOOK AND TAPE BEING SENT SPECIAL 4th CLASS MAIL.

THANKS FOR THE ORDER!

FRED BLECHMAN

**Sample Address Label**

JOE DOAKS
123 4th ST.
ANYTOWN CA 91399

respond with N to the remarks query. When you've finished your remarks, the program prints "Thanks for the Order!" followed by your name, then moves beyond the bottom of the invoice for easy removal from the printer.

Now you can print as many address labels as you need after removing your invoice and positioning the printer paper. The labels may be applied with rubber cement or any other adhesive. I prefer 2" clear plastic tape to protect the label as well as hold it in place.

### Special Program Commands

There are three special commands in this program that require some explanation. Two of them involve the Microline 80 printer. Your printer may require a different command. In program line 70, the LPRINTCHR$(29) sets the printer to 16.5 characters per inch instead of the normal 10. This condensed printing is necessary to get a reasonable amount of information on the 4½" wide invoice I use. In line 820, the LPRINTCHR$(30) returns the printer to 10 characters per inch for printing address labels.

The last program line, 2000, allows you to make two complete program copies on cassette with a two-second gap between them. Just Type and Enter RUN 2000 with your recorder ready to record. This works without change for the Model I. However, for the Model III, change OUT255,4 to OUT236,2. Other than that, the rest of the program will work with either Model I Level II or Model III BASIC.

So there it is. I've found this program saves me time, eliminates errors and confusion, makes my invoices consistent and provides a professional image for my small software business. If you wish to save program entry/debugging time, send $6 to Blechman Enterprises, 7217 Bernadine Ave., Canoga Park, CA 91307 (213)346-7024 for a program cassette (postpaid USA and Canada; $2 shipping foreign. CA residents add 6% sales tax) complete with an actual invoice!

---

This program is one of six programs in the Small Home Business Package available for $29.95 from the author. Write him for details.

---

**Program Variables**
**In Order of Appearance**

| | |
|---|---|
| DA$ | Date |
| P$ | Phone number |
| N$ | Customer name |
| A1$ | First address line |
| A2$ | Second address line |
| A3$ | Third address line |
| T | Total item price |
| TT | Total order price |
| X | READ-DATA counter |
| A$(X) | Item description |
| P(X) | Item each price |
| M | Menu item number |
| Q | Quantity |
| PR$ | PRINTUSING item format string |
| TT$ | PRINTUSING total format string |
| X$ | Sales tax Y/N response |
| H | Shipping/handling charge |
| PAY$ | Check Y/N response |
| CH | Check number |
| CA | Check amount |
| OP | Overpaid amount |
| AD | Amount due |
| R$ | Remark Y/N response |
| X | Blank line counter |
| L$ | Label Y/N response |
| X | Continue program response |
| D$ | Item description |
| P | Price each |
| I | Interval loop counter |

**Listing 1**
**Small Business Invoice Program**
**for Models I and III**

```
10 CLS:CLEAR200:REM * COPYRIGHT FRED BL
ECHMAN 1981 * 5/23/81 *
20 PRINT:PRINT"BLECHMAN ENTERPRISES INV
OICE PROGRAM:
30 PRINT:PRINT"PLACE NCR 5-1/2 X 4-1/4
INVOICE FORM IN PRINTER, WITH LEFT EDGE
40 PRINT"OF FORM AT LEFT EDGE OF CUTTIN
G BAR, AND LOWER LINE OF LOGO AT
50 PRINT"THE TOP OF THE CUTTING BAR....
60 PRINT:PRINT"MAKE SURE PRINTER IS ON
AND READY.....":PRINT:PRINT
70 PRINT:LPRINTCHR$(29)
80 INPUT"DATE (MM/DD/YY)";DA$:LPRINT DA
$;:LPRINTTAB(30)
90 INPUT"ENTER PHONE, IF KNOWN...";P$:I
F P$<>"" LPRINT"PHONE:";P$:ELSE LPRINT"
PHONE: UNKNOWN"
100 PRINT:LPRINT" "
110 REM * ENTER NAME AND ADDRESS - 4-LI
NES MAX. *
120 INPUT"NAME";N$:LPRINTN$
130 A1$=" ":INPUT"ADDRESS LINE (NO COMM
AS)";A1$:LPRINTA1$
140 A2$=" ":INPUT"ADDRESS LINE (NO COMM
AS)";A2$:LPRINTA2$
150 A3$=" ":INPUT"ADDRESS LINE (NO COMM
AS)";A3$:LPRINTA3$
160 T=0:TT=0
200 LPRINT" ":REM * SELECT ORDERED ITEM
S *
210 FOR X=1TO10
220 READ A$(X),P(X):IF A$(X)="END" GOTO
240
230 NEXTX
240 CLS:PRINT:PRINT"WHICH OF THE FOLLOW
ING ITEMS ARE ORDERED?"
250 PRINT:PRINT"(1) ";A$(1)
```

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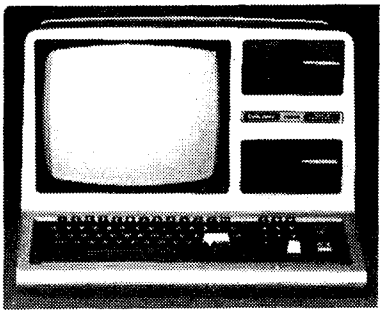
| 2 dual sided 80 track drives | 2395.00 |
| with RS-232 C Add | 115.00 |

NOTE: These Model III computers contain Apparat installed disk drives and memory. They are warranted by Apparat, Inc. for 90 days.



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|---|---|
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| | |
|---|---|
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| 8" plastic library case | $ 4.95 |
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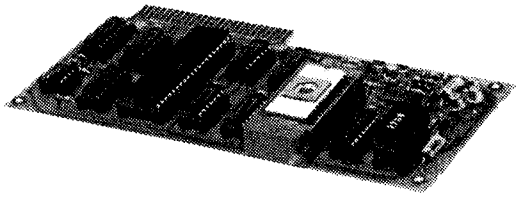

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Interactive G/L, A/R, A/P & checkbook manager

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Universal terminal program that takes advantage of the extended NEWDOS/80 commands

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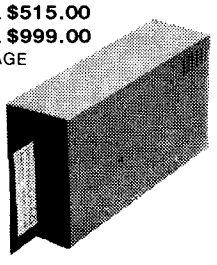

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| Documentation | ☐ | ☐ | ☐ | ☑ |
| Ease of Use | ☐ | ☐ | ☑ | ☐ |
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Circle # 15

```
260 PRINT"(2) ";A$(2)
270 PRINT"(3) ";A$(3)
280 PRINT"(4) ";A$(4)
285 PRINT"(5) ";A$(5)
290 PRINT"(6).....SPECIAL ORDER ITEM..
....."
300 PRINT"(7).....END OF ORDER....."
310 PRINT:INPUT"PRESS 1,2,3,4,5,6  OR 7
 ONLY....AND ENTER";M
320 IF M<1 OR M>7 GOTO 310
330 IF M=6 OR M=7 GOTO400
340 PRINT:PRINT"HOW MANY ";A$(M);:INPUT
" ORDERED";Q:T=Q*P(M):TT=TT+T
400 PR$="###    %
                    %  ####.##"
410 TT$="%
                   %   ####.##"
420 IF M=6 GOTO900
430 IF M=7 GOTO500
440 LPRINTUSINGPR$;Q;A$(M);T
450 GOTO240
500 PRINTSTRING$(62,"-"):PRINTUSINGTT$;
"      TOTAL.....";TT
510 LPRINTSTRING$(62,"-"):LPRINTUSINGTT
$;"                          TOTAL.....
..............";TT
520 PRINT:INPUT"SALES TAX (Y/N)";X$
530 IFX$="Y" THEN T=.06*TT:T=INT(T*100+
.5)/100:PRINTUSINGTT$;"     TAX....";T:
LPRINTUSINGTT$;"
   6% CA SALES TAX.....";T:TT=TT+T
540 PRINT:INPUT"ENTER SHIPPING/HANDLING
 (0 IF NONE)";H:TT=TT+H
550 PRINTUSINGTT$;"     HANDLING.......
";H:LPRINTUSINGTT$;"
      SHIPPING/HANDLING........";H
560 PRINTUSINGTT$;"     GRAND TOTAL....
.........";TT:LPRINTUSINGTT$;"
                  GRAND TOTAL.........
....";TT
570 LPRINT" ":INPUT"PAID CHECK (Y/N)";P
AY$
580 IF PAY$="Y" INPUT"CHECK NUMBER";CH:
LPRINT"PAID CHECK #";CH;
590 IF PAY$="Y" INPUT"CHECK AMOUNT";CA:
LPRINT"$";CA;
600 OP=CA-TT:AD=TT-CA:OP=INT(OP*100+.5)
/100:AD=INT(AD*100+.5)/100
610 IF OP>0 PRINT"OVERPAID $";OP:LPRINT
"OVERPAID $";OP;"! REFUND ENCLOSED.":GO
TO650
620 IF AD>0 PRINT"AMOUNT DUE: $";AD:LPR
INT"AMOUNT DUE: $";AD;". PLEASE REMIT."
:GOTO650
630 IF OP=0 AND AD=0 THEN PRINT"  CORRE
CT AMOUNT.":LPRINT" CORRECT AMOUNT.":GO
TO650
640 LPRINT" ":PRINT
650 INPUT"ANY REMARKS (Y/N)";R$
660 IF R$="Y" THEN R$=" ":PRINT"TYPE AN
D ENTER REMARKS, STARTING WITH QUOTE":I
NPUTR$
670 IF R$="N" GOTO800
680 LPRINTR$:GOTO650
800 LPRINT" ":LPRINT"THANKS FOR THE ORD
ER!"
810 LPRINT"                                FR
ED BLECHMAN
820 FORX=1TO5:LPRINT" ":NEXTX:PRINT:LPR
INTCHR$(30)
825 L$="Y":INPUT"ADDRESS LABEL (Y/N)";L
$
830 IF L$="Y" INPUT"REMOVE INVOICE AND
PREPARE PRINTER PAPER. PRESS ENTER...";
X
840 IFL$="Y" LPRINTN$:LPRINTA1$:LPRINTA
2$:LPRINTA3$
845 INPUT"ANOTHER LABEL (Y/N)";L$:IF L$
="Y" LPRINT" ":LPRINT" ":GOTO840
850 CLEAR50:END
900 PRINT:INPUT"DESCRIPTION OF ITEM";D$
910 INPUT"PRICE EACH";P:INPUT"HOW MANY"
;Q:T=Q*P:TT=TT+T
920 LPRINTUSINGPR$;Q;D$;T:GOTO240
1000 DATA AMWAY PRODUCT DISTRIBUTOR PRO
GRAMS,30
1010 DATA SMALL HOME-BUSINESS PROGRAMS,
25
1015 DATA ORDER VERIFICATION UPDATE,10
1020 DATA"''PROGRAMS FOR BEGINNERS.....
'' BOOK",8.95
1030 DATA TELEPHONE PROGRAMS,10
1200 DATA END,0
2000 CSAVE"1":OUT255,4:FORI=1TO2000:NEX
T:CSAVE"1"
```

**Listing 2**
**Small Business Invoice Program**
**For the Color Computer**

```
10 CLS:CLEAR200
20 PRINT:PRINT:PRINT:PRINT"PLACE NCR 5-
1/2 X 4-1/4 INVOICE FORM IN PRINTER, WI
TH LEFT EDGE OF FORM AT LEFT EDGE OF CU
TTING BAR, AND LOWER LINE OF LOGO AT
50 PRINT"THE TOP OF THE CUTTING BAR."
60 PRINT:PRINT"MAKE SURE PRINTER IS ON
AND READY.....":PRINT:PRINT
70 PRINT:PRINT#-2,CHR$(29)
80 INPUT"DATE (MM/DD/YY)";DA$:PRINT#-2,
DA$;:PRINT#-2,TAB(30)
90 INPUT"ENTER PHONE, IF KNOWN...";P$:I
FP$<>"" THEN PRINT#-2,"PHONE:";P$:ELSE
PRINT#-2,"PHONE: UNKNOWN"
```

```
100 PRINT:PRINT#-2," "
110 REM *ENTER NAME AND ADDRESS -4- LIN
ES MAX. *
120 INPUT"NAME";N$:PRINT#-2,N$
130 A1$=" ":INPUT"ADDRESS LINE (NO COMM
AS)";A1$:PRINT#-2,A1$
140 A2$=" ":INPUT"ADDRESS LINE (NO COMM
AS)";A2$:PRINT#-2,A2$
150 A3$=" ":INPUT"ADDRESS LINE (NO COMM
AS)";A3$:PRINT#-2,A3$
160 T=0:TT=0
200 PRINT#-2," ":REM SELECT ORDERED ITE
MS
210 FOR X=1TO10
220 READ A$(X),P(X):IFA$(X)="END"GOTO24
0
230 NEXT X
240 CLS:PRINT:PRINT"WHICH OF THE FOLLOW
ING ITEMS ARE ORDERED"
250 PRINT:PRINT"(1) ";A$(1)
260 PRINT"(2) ";A$(2)
270 PRINT"(3) ";A$(3)
280 PRINT"(4) ";A$(4)
285 PRINT"(5) ";A$(5)
290 PRINT"(6)  <SPECIAL ORDER ITEM>"
300 PRINT"(7)  <END OF ORDER>"
310 PRINT:INPUT"PRESS 1,2,3,4,5,6 OR 7
ONLY AND ENTER";M
320 IF M<1 OR M>7 GOTO 310
330 IF M=6 OR M=7 GOTO 400
340 PRINT:PRINT"HOW MANY ";A$(M);:INPUT
" ORDERED";Q:T=Q*P(M):TT=TT+T
400 PR$="###   %
                    %  ####.##"
410 TT$="%
                     %   ####.##"
420 IF M=6 GOTO 900
430 IF M=7 GOTO 500
440 PRINT#-2,USINGPR$;Q;A$(M);T
450 GOTO 240
500 PRINTSTRING$(62,"-"):PRINTUSING TT$
;"      TOTAL.....";TT
510 PRINT#-2,STRING$(62,"-"):PRINT#-2,U
SINGTT$;"                              TOT
AL.....";TT
520 PRINT:INPUT"SALES TAX (Y/N)";X$
530 IFX$="Y"THEN T=.06*TT:T=INT(T*100+.
5)/100:PRINTUSINGTT$;"      TAX....";T:P
RINT#-2,USINGTT$;"
      6% CA SALES TAX.....";T:TT=TT
+T
540 PRINT:INPUT"ENTER SHIPPING/HANDLING
(0 IF NONE";H:TT=TT+H
550 PRINTUSINGTT$;"      HANDLING.....
";H:PRINT#-2,USINGTT$;"  HANDING.....
...";H
560 PRINTUSINGTT$;"      GRAND TOTAL....
.....";TT:PRINT#-2,USINGTT$;"
                    GRAND TOTAL.....
.....";TT
570 PRINT#-2," ":INPUT"PAID CHECK (Y/N)"
;PAY$
580 IF PAY$="Y" THEN INPUT"CHECK NUMBER
";CH:PRINT#-2,"PAID CHECK #";CH;
590 IF PAY$="Y" THEN INPUT"CHECK AMOUNT
";CA:PRINT#-2,"$";CA;
600 OP=CA-TT:AD=TT-CA:OP=INT(OP*100+.5)
/100:AD=INT(AD*100+.5)/100
610 IF OP>0 THEN PRINT"OVERPAID $";OP:P
RINT#-2,"OVERPAID $";OP;" REFUND ENCLOS
ED.":GOTO650
620 IF AD>0 THEN PRINT"AMOUNT DUE: $";A
D:PRINT#-2,"AMOUNT DUE: $";AD;".PLEASE
REMIT. ":GOTO650
630 IF OP=0 AND AD=0 THEN PRINT"CORRECT
 AMOUNT.":PRINT#-2," CORRECT AMOUNT.":G
OTO650
640 PRINT#-2," ":PRINT
650 INPUT"ANY REMARKS (Y/N)";R$
660 IF R$="Y" THEN R$=" ":PRINT"TYPE AN
D ENTER REMARKS, STARTING WITH QUOTE":I
NPUT TR$
670 IF R$="N" GOTO 800
680 PRINT#-2,TR$:GOTO650
800 PRINT#-2," ":PRINT#-2,"THANKS FOR T
HE ORDER!"
810 PRINT#-2,"
 FRED BLECHMAN"
820 FORX=1TO5:PRINT#-2," ":NEXTX:PRINT:
PRINT#-2,CHR$(30)
825 L$="Y":INPUT"ADDRESS LABEL (Y/N)";L
$
830 IF L$="Y" THEN INPUT"REMOVE INVOICE
 AND PREPARE PRINTER PAPER. PRESS ENTER
...";X
840 IF L$="Y" THEN PRINT#-2,N$:PRINT#-2
,A1$:PRINT#-2,A2$:PRINT#-2,A3$
850 CLEAR 50:END
900 PRINT:INPUT"DESCRIPTION OF ITEM";D$
910 INPUT"PRICE EACH";P:INPUT"HOW MANY"
;Q:T=Q*P:TT=TT+T
920 PRINT#-2,USINGPR$;Q;D$;T:GOTO240
1000 DATA AMWAY PRODUCT DISTRIBUTOR PRO
GRAMS,30
1010 DATA SMALL HOME-BUSINESS PROGRAMS,
25
1015 DATA ORDER VERIFICATION UPDATE,10
1020 DATA"''PROGRAMS FOR BEGINNERS.....
'' BOOK",8.95
1030 DATA TELEPHONE PROGRAMS,10
1200 DATA END,0
1300 END
```

■

# Interest calculations

## *Generate comparative data with your microcomputer*

**Model I/III**

Charles R. Jones, Germantown, MD

This program manipulates several variations of interest calculations in a manner that is somewhat instructional as well as useful. The first three types of interest calculations allow experimentation by allowing any of the variables to be "unknown". They are progressively more difficult and lead into the last three variations, which sound more complex but are actually just as straightforward. The six aspects of interest calculations presented (simple, compound, debt payments, savings accumulation, annuities and perpetuities) represent the most concise yet complete program that you will be likely to find anywhere.

The fourth variation uses a printer since it is a little more complex. One of my friends tried to get a savings account forecast from his bank, assuming that he deposited his retirement check every month at the new high interest rates. His check increases annually with the cost of living, but Uncle Sam has to have his cut. Needless to say, his bank could not help, and he asked me to generate some comparison data on my TRS-80.

Many of us freeze up and stumble over problems like this which are supposedly a snap. All that is needed is a quick reminder of the variables involved and a program to sort out the question that we are really asking. For example, the third variation will refine your debt payments to fit the other data that you have. If it is to provide the number of payments, it will usually give you an extra payment at a reduced rate rather than a fractional payment. Likewise, it will look for the first quarter percent interest rate that satisfies the data since most payments are based on fractional interest rather than decimal parts.

**Program Listing for Interest Calculations**

```
10 ' INTEREST CALCULATIONS
20 ' COPYRIGHT 1981 BY CHARLIE JONES
30 ' REFERENCE TEXT: ENGINEERING ECONOM
  Y BY E. PAUL DeGARMO
40 DEFDBL I,P,N,R,S,B
50 CLS:PRINT "INTEREST CALCULATIONS IND
  EX":PRINT:PRINT
60 PRINT "    1. SIMPLE INTEREST"
70 PRINT "    2. COMPOUND INTEREST (BASI
  C)"
80 PRINT "    3. DEBT PAYMENTS"
90 PRINT "    4. SAVINGS ACCUMULATIONS"
100 PRINT "    5. ANNUITIES"
110 PRINT "    6. PERPETUITIES "
120 PRINT:PRINT:INPUT "    ENTER THE NUM
  BER DESIRED";IX:IF IX>6THEN120  ELSE
  CLS:ON IX GOTO 130  ,390  ,560  ,850
   ,1320 ,1450
130 PRINT "SIMPLE INTEREST: I=P*N*R , W
  HERE I IS THE AMOUNT OF"
```

# QUALITY SOFTWARE FOR TRS-80 COLOR!

**ADVENTURES!!!!**

**For TRS-80, and COLOR-80.** These Adventures are written in BASIC, are full featured, fast action, full plotted adventures that take 30-50 hours to play. (Adventures are inter-active fantasies. It's like reading a book except that you are the main character as you give the computer commands like "Look in the Coffin" and "Light the torch.")

Adventures require 16K on COLOR-80 and TRS-80. They sell for $14.95 each.

**ESCAPE FROM MARS**
(by Rodger Olsen)
This ADVENTURE takes place on the RED PLANET. You'll have to explore a Martian city and deal with possibly hostile aliens to survive this one. A good first adventure.

**PYRAMID** (by Rodger Olsen)
This is our most challenging ADVENTURE. It is a treasure hunt in a pyramid full of problems. Exciting and tough!

**TREK ADVENTURE** (by Bob Retelle)
This one takes place aboard a familiar starship. The crew has left for good reasons - but they forgot to take you, and now you are in deep trouble.

**DEATH SHIP** (by Rodger Olsen)
Our first and original ADVENTURE, this one takes place aboard a cruise ship - but it ain't the Love Boat.

**VAMPIRE CASTLE** (by Mike Bassman)
This is a contest between you and old Drac - and it's getting a little dark outside. $14.95 each.

**SPACE SHUTTLE**
**ONE OR TWO PLAYER HIGH RES GAME** — Your mission is to dock with an orbiting space platform — but you may have to land on the planetary surface for refueling first. A real value in a high res real time game. $6.95.

**KILLERBOT** — (Available in 4K) — Real time action at 20 levels of difficulty as you run, sneak, and dodge your way through a bloody field of Killer Robots. Get across or die! Joysticks or Keyboard controls. TRS-80 COLOR (ANY BASIC 4K or more.). $9.95.

**SLASHBALL** (Available in 4K) — This one is best described as a thinkers arcade game. It rewards fast reflexes and clear thinking — like nothing you have ever seen before. It is one of our best family games for one or two players. $9.95.

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**BATTLEFLEET** - This grown up version of Battleship is the toughest thinking game available on OSI or 80 computers. There is no luck involved as you seek out the computers hidden fleet. A topographical toughie. $9.95

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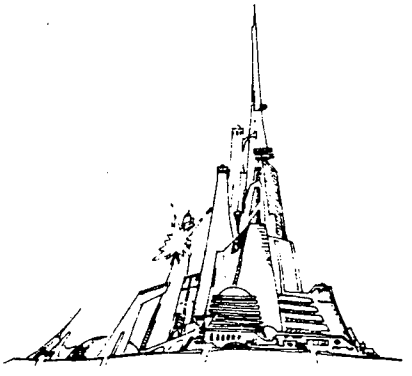

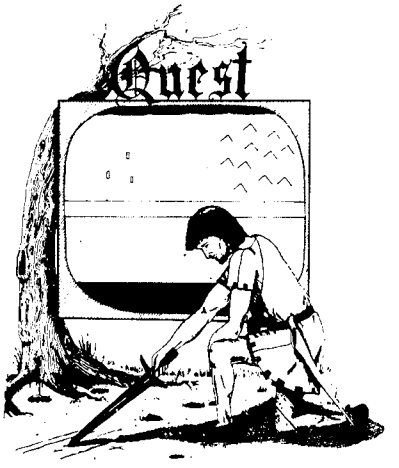


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**AARDVARK - 80**

**TRS 80** **2352 S. Commerce, Walled Lake, MI 48088** **TRS 80 COLOR**

**(313) 669-3110**

Circle # 16

```
140 PRINT "INTEREST IN DOLLARS, P IS TH
  E PRINCIPAL OR PRESENT"
150 PRINT "WORTH OF THE MONEY INVOLVED,
   N IS THE NUMBER OF"
160 PRINT "INTEREST PERIODS, AND R IS T
  HE INTEREST RATE % "
170 PRINT "PER PERIOD."
180 PRINT:PRINT
190 INPUT "WHICH VALUE IS UNKNOWN (ENTE
  R I,P,N OR R) ";U$
200 IF U$="I" THEN GOSUB 310  :GOSUB 32
  0  :GOSUB 330  :GOSUB 340  :GOTO 250

210 IF U$="P" THEN GOSUB 380  :GOSUB 32
  0  :GOSUB 330  :GOSUB 350  :GOTO 250

220 IF U$="N" THEN GOSUB 380  :GOSUB 31
  0  :GOSUB 330  :GOSUB 360  :GOTO 250

230 IF U$="R" THEN GOSUB 380  :GOSUB 31
  0  :GOSUB 320  :GOSUB 370  :GOTO 250

240 GOTO190
250 CLS:PRINT "INTEREST (I) : ";:IF I=0
   THEN PRINT USING "$$####.##";S-P ELS
  E PRINT USING "$$####.##";I
260 PRINT"PRINCIPAL (P): ";USING "$$###
  #.##";P:IF S=0 THEN S=P
270 PRINT "PRINCIPAL PLUS INTEREST: ";U
  SING "$$####.##";I+S
280 PRINT"PERIODS (N)  :  ";USING "##.#
  ";N
290 PRINT"RATE (R)     :  ";USING "##.#
  ###";R*100;:PRINT " %"
300 PRINT:PRINT:INPUT "ENTER TO RETURN
  TO INDEX";I:RUN
310 INPUT "ENTER THE PRINCIPAL (P):";P:
  RETURN
320 INPUT "ENTER # OF PERIODS  (N):";N:
  RETURN
330 INPUT "ENTER INTEREST RATE PER PERI
  OD (R), IN PERCENT:";R:R=R/100:RETURN

340 I=P*N*R:RETURN
350 P=I/(N*R):RETURN
360 N=I/(P*R):RETURN
370 R=I/(P*N):RETURN
380 INPUT "AMOUNT OF INTEREST (I):";I:R
  ETURN

390 PRINT "COMPOUND INTEREST: S=P*(1+R/
  100)^N, WHERE S IS THE TOTAL"
400 PRINT "AMOUNT DUE IF THE INTEREST B
  ECOMES PRINCIPAL AT THE"
410 PRINT "END OF EACH PERIOD, P IS THE
   PRINCIPAL AMOUNT AT"
420 PRINT "THE START, R IS THE INTEREST
   RATE IN PERCENT FOR"
430 PRINT "EACH PERIOD, AND N IS THE NU
  MBER OF PERIODS."
440 PRINT:PRINT
450 INPUT "WHICH VALUE IS UNKNOWN (ENTE
  R S,P,R OR N) ";U$
460 IF U$="S" THEN GOSUB 310  :GOSUB 32
  0  :GOSUB 330  :GOSUB 510  :GOTO250

470 IF U$="P" THEN GOSUB 550  :GOSUB 32
  0  :GOSUB 330  :GOSUB 520  :GOTO250

480 IF U$="R" THEN GOSUB 550  :GOSUB 32
  0  :GOSUB 310  :GOSUB 530  :GOTO250

490 IF U$="N" THEN GOSUB 550  :GOSUB 31
  0  :GOSUB 330  :GOSUB 540  :GOTO250

500 GOTO450
510 S=P*((1+R)^N):I=S-P:RETURN
520 P=S/((1+R)^N):RETURN
530 R=((S/P)^(1/N))-1:RETURN
540 N=(LOG(S)-LOG(P))/LOG(1+R):RETURN
550 INPUT "TOTAL, INTEREST PLUS PRINCIP
  AL : ";S:RETURN
560 PRINT "DEBT PAYMENTS":PRINT:PRINT
570 PRINT "P=B(R(1+R)^N)/((1+R)^N-1), W
  HERE P IS THE PAYMENT TO"
580 PRINT "BE MADE EACH PERIOD ON THE B
  ALANCE (B), IF THE INTEREST"
590 PRINT "RATE R (ACTUALLY R%/1200) IS
   PAID FOR EACH PERIOD."
600 PRINT "THE PROGRAM ASSUMES AN ANNUA
  L PERCENTAGE RATE AND"
610 PRINT "MONTHLY PAYMENTS SO ENTER DA
  TA AS SUCH."
620 PRINT:PRINT:INPUT "WHICH VALUE IS U
  NKNOWN (ENTER P,B,R OR N) ";U$
630 IF U$="P"THEN GOSUB 740  :GOSUB 750
     :GOSUB 770  :GOSUB 780  :GOTO 680

640 IF U$="B" THEN GOSUB 740  :GOSUB 75
  0  :GOSUB 760  :GOSUB 790  :GOTO 680

650 IF U$="R" THEN GOSUB 750  :GOSUB 76
  0  :GOSUB 770  :PRINT:PRINT"FINDING M
  AXIMUM QUARTER PERCENT...":GOSUB 800
   :GOTO 680
660 IF U$="N" THEN GOSUB 740  :GOSUB 76
  0  :GOSUB 770  :PRINT "CONDUCTING COM
  PUTATION TO FIND MAXIMUM N":IF P<R*BT
  HEN PRINT"PAYMENT MUST EXCEED";R*B:GO
  TO 660  ELSE N=INT(B/P)-1:GOSUB 820
  :GOTO 680
670 GOTO 620
```

***This Grizzly Looking Character Is Losing The Bug Battle!***

TOO BAD! He continues to "WHIP" those miserable varmits the hard way . . . while the real answer is at his fingertips. He's not alone either! BUGS are an inevitable part of programming, and if you have ever tried to program in Assembly/Machine Language, you know exactly what we are talking about.

When we purchased our first TRS-80*, we were no strangers to machine language programming. We tossed out BASIC the first day, preferring to get right down to the nuts and bolts of things. What a shock! The Debugging Aids at the machine level were horrible! They were awkward to read, did not provide enough, or the right kinds of information, and required eight hands and gymnastic ability to switch from one command to another. Ridiculous!

## WE DIDN'T SUFFER LONG!

Our first project was to create a truly powerful Debugging Tool. We called it *BUGOUT*, ran some advertisements, and sold a bundle of them. You know, the American dream come true. But that wasn't the end of our quest for a truly superior product. We asked every *BUGOUT* customer to give us their best ideas. Ideas that would make our product far superior to any other Debugger, and believe us, some of our customers are absolutely brilliant!

We received a truck-load of fantastic ideas, and you guessed it, we overhauled the original *BUGOUT* and created the most powerful, versatile, and easy to use Machine Language Debugger ever written for Mod I or III computers. . . BAR NONE!

## HERE IT COMES

Our new Debugger is called *BUGOUT/PRO*. It is 11.5K of extremely powerful coding, and it is simply loaded with marvelous options waiting to come to the aid of beginner and expert alike. Anyone who is even remotely involved with Assembly/Machine Language programming can use *BUGOUT/PRO*. It comes with two manuals, one for beginners, with an INTERACTIVE course of instruction, and one for experts, with all the advanced features clearly spelled out.

## WHAT DOES IT DO?

*BUGOUT/PRO* does all the things you would expect a Debugger to do, and more . . . a lot more! Beyond that, and even more important than what it does, is how it does it, how the data is displayed, and how easy it is to use!

*TRS-80 IS A TRADEMARK OF TANDY CORP

You must *EXPERIENCE* the fast, flicker-free display, the utter simplicity of operation, and the huge variety of commands to make a fair appraisal of this product. No advertisement could possibly tell it all . . . so we are saving the best features for our *RISK-FREE* home examination.

## RISK-FREE EXAMINATION

That's right, you can examine *BUGOUT/PRO* in your own home or office with our 100% guarantee of satisfaction. If *BUGOUT/PRO* doesn't live up to your expectations, simply return it for a full refund. What could be more fair?

*BUGOUT/PRO* sells for **$69.95** and is worth every penny we ask, and more! Just think of all the hours you've wasted searching for bugs. *BUGOUT/PRO* will make Assembly/Machine Language programming faster, easier, and far more enjoyable. Beginner or expert, *BUGOUT/PRO* is the Cadillac, Lincoln, and Rolls Royce of Debuggers rolled into one.

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When you own *BUGOUT/PRO*, you are on the road to winning the bug battle. *BUGOUT/PRO* is supplied on TAPE or DISK, and either version automatically runs on both Mod I and Mod III computers. TAPE and DISK versions are identical, but be sure to specify which one you want. We accept Master Charge, Visa, Money Order, or Personal Checks. Foreign Orders and C.O.D.'s are $5.00 extra. Washington state residents add 5.3% sales tax.

Take advantage of our RISK-FREE offer today. **BUGOUT/PRO** is a must investment for all machine language programmers.

**German Language Edition** available in Europe from **Hanspeter Schmid**, Lenaustr. 2, 6906 Leimen, W. Germany.

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**Circle # 17**

```
680 CLS:PRINT "MONTHLY PAYMENTS OF :  "
  ;USING "$$####.##";P:IF PX<>0.0 THEN
  PRINT "ACTUAL PAYMENT BASED ON CALCUL
  ATIONS IS : ";USING "$$####.##";PX
690 PRINT "TO PAYOFF A BALANCE OF :";US
  ING "$$####.##";B
700 PRINT "IN ";N;"MONTHS WITH AN ANNUA
  L RATE OF ";USING "##.##";R*1200;:PRI
  NT "%"
710 PX=P
720 PRINT:PRINT "TOTAL ACTUAL INTEREST
  (P*N-B):  ";USING "$$####.##";PX*N-B
730 PRINT:PRINT:INPUT "ENTER TO RETURN
  TO INDEX";I:RUN
740 INPUT "WHAT IS ANNUAL INTEREST RATE
   IN PERCENT (R)";R:R=R/1200:RETURN
750 INPUT "HOW MANY MONTHS ARE PAYMENTS
   TO BE MADE (N)";N:RETURN
760 INPUT "WHAT IS THE MONTHLY PAYMENT
  (P) ";P:RETURN
770 INPUT "WHAT IS THE CURRENT BALANCE
  (B) ";B:IF B<P THEN PRINT "BALANCE MU
  ST BE MORE THAN PAYMENT...":FOR W=1 T
  O 1000:NEXT W:CLS:GOTO 560  ELSE RETU
  RN
780 P=B*(R*(1+R)^N)/(((1+R)^N)-1):RETUR
  N
790 B=P*(((1+R)^N)-1)/(R*((1+R)^N)):RET
  URN
800 R=R+.0025/12:GOSUB 840
810 IF (P-PX)<=0.0 THEN RETURN ELSE GOT
  O 800
820 N=N+1:GOSUB840
830 IF (P-PX)>=0.0 THEN RETURN ELSE GOT
  O 820
840 PX=B*(R*(1+R)^N)/(((1+R)^N)-1):RETU
  RN
850 CLS:PRINT "SAVINGS ACCUMULATIONS"
860 PRINT:PRINT:PRINT "IF A MONTHLY PAY
  MENT (P) IS MADE TO A SAVINGS ACCOUNT
  ,"
870 PRINT "THE INTEREST IS COMPOUNDED E
  VERY N MONTHS, AND THE "
880 PRINT "MONTHLY PAYMENTS INTO THE AC
  COUNT ARE INCREASED BY AN"
890 PRINT "AMOUNT THAT REPRESENTS THE A
  NNUAL RATE OF INFLATION,"
900 PRINT "A REALISTIC FORECAST CAN BE
  MADE AS TO THE ACTUAL"
910 PRINT "ACCUMULATION OF MONEY IN THE
   ACOUNT, EXCEPT FOR TAXES"
920 PRINT "(WHICH YOU CAN, PERHAPS, EST
  IMATE)."
930 PRINT:PRINT:INPUT "AMOUNT OF INITIA
  L MONTHLY PAYMENT (FIRST 12 MONTHS)";
  P
940 LPRINT "INITIAL PAYMENT : ";USING "
  $$####.##";P;
950 INPUT "HOW MANY MONTHS BETWEEN COMP
  OUNDING ";N:IF (N<>1)AND(N<>2)AND(N<>
  3)AND(N<>4)AND(N<>6)AND(N<>12)THEN PR
  INT "MUST USE 1,2,3,4,6, OR 12":GOTO9
  50
960 LPRINT " COMPOUNDED AT";N;"MONTH IN
  TERVALS"
970 INPUT "PERCENTAGE INTEREST FOR COMP
  OUNDING (SIMPLE ANNUAL RATE)";R
980 LPRINT "AT AN ANNUAL RATE OF";R;"PE
  RCENT.  ";
990 INPUT "AVERAGE ANNUAL INFLATION RAT
  E FOR PAYMENTS";I

1000 LPRINT "PAYMENTS ARE INCREASED ANN
  UALLY AT";I;"PERCENT ";
1010 INPUT "NUMBER OF YEARS ALLOWED TO
  ACCUMULATE";Y
1020 LPRINT "FOR";Y;"YEARS.";
1030 INPUT "AVERAGE ANNUAL TAX RATE EXP
  ECTED, PERCENT: ";TP
1040 LPRINT "  WE EXPECT AN AVERAGE TAX
   RATE OF";TP;"PERCENT ANNUALLY."
1050 FOR YT=1 TO Y
1060 FOR AN=1TO(12/N)
1070 FOR CN=1 TO N
1080 ST=P+ST:IC=IC+ST
1090 M=M+1
1100 PRINT "MONTH:";M;"  YEAR:";USING "
  ##.##";M/12;:PRINT "   PAYMENTS:";USI
  NG "$$####.##";P;:PRINT"   TOTAL: ";U
  SING "$$#####.##";ST
1110 NEXT CN
1120 AS=IC/N:XT=R*AS*N/1200:IC=0
1130 PRINT "INTEREST PAYMENT : ";USING
  "$$####.##";XT
1140 TM=TM+XT:TI=TI+XT
1150 ST=ST+XT
1160 NEXT AN
1170 LPRINT "YEAR: ";YT;"     PAYMENTS:
   ";USING "$$#####.##";P;:LPRINT "
   TOTAL SAVINGS: ";USING "$$#####.##";
  ST
1180 P=P+I*P/100
1190 TX=TP*TM/100:LPRINT"MINUS ANNUAL T
  AX = ";USING "$$####.##";TX;
1200 LPRINT "  NET SAVINGS: ";USING "$$
  #####.##";ST-TX
1210 LPRINT " "
1220 PRINT "ANNUAL TAX :";USING "$$####
  .##";TX
1230 TM=0:TT=TT+TX:ST=ST-TX:PRINTTT
1240 NEXT YT
1250 PRINT:PRINT:PRINT "FINAL AMOUNT IS
   ";USING "$$#######.##";ST
1260 LPRINT "  ":LPRINT "  ":LPRINT "FI
  NAL AMOUNT IS : ";USING "$$######.##"
  ;ST
```

```
1270 PRINT "TOTAL INTEREST RECEIVED :";
  USING "$$####.##";TI
1280 LPRINT "TOTAL INTEREST RECEIVED :
  ";USING "$$####.##";TI;
1290 PRINT "TOTAL TAXES PAID: ";USING "
  $$####.##";TT
1300 LPRINT "   TOTAL TAXES PAID : ";US
  ING "$$####.##";TT
1310 PRINT:PRINT:INPUT "ENTER TO RETURN
   TO INDEX ";I:RUN
1320 PRINT "ANNUITIES :  FINDING THE PR
  ESENT WORTH (VALUE) OF"
1330 PRINT "AND ANNUITY OF Y YEARS PAYI
  NG P AMOUNT EVERY YEAR,
1340 PRINT "WITH AN ANNUAL NOMINAL INTE
  REST, R."
1350 PRINT:PRINT
1360 PRINT "W=P*((1+R)^Y-1)/(R(1+R)^N)"

1370 PRINT:PRINT
1380 INPUT "HOW MANY YEARS";N
1390 INPUT "HOW MUCH IS TO BE PAID EVER
  Y YEAR";P
1400 INPUT "WHAT IS THE ANNUAL NOMINAL
  INTEREST IN PERCENT";R:R=R/100
1410 GOSUB 790
1420 PRINT "THE PRESENT WORTH IS ";USIN
  G "$$####.##";B
1430 PRINT:PRINT
1440 INPUT "ENTER TO RETURN TO INDEX";R
  :RUN
1450 PRINT "TO MAKE A CERTAIN AMOUNT AV
  AILABLE FOREVER, AN"
1460 PRINT " AMOUNT OF CAPITAL MUST BE
  INVESTED AT"
1470 PRINT "AN INTEREST RATE, R, SUCH T
  HAT INTEREST = SPENDING ."
1480 PRINT:PRINT
1490 PRINT "THE PRESENT WORTH OF A PERP
  ETUITY HAVING PAYMENTS P"
1500 PRINT "IS P/(R/100)."
1510 PRINT:PRINT
1520 INPUT "WHAT IS THE PAYMENT AMOUNT"
  ;P
1530 INPUT "WHAT IS THE NOMINAL ANNUAL
  INTEREST RATE IN PERCENT";R
1540 W=P*100/R
1550 PRINT:PRINT:PRINT "AN INVESTMENT O
  F";USING "$$####.##";W;:PRINT" IS REQ
  UIRED."
1560 PRINT:PRINT:INPUT "ENTER TO RETURN
   TO INDEX";R:RUN
```

■

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Circle # 18

# Screen printing with MX-80

## *Dump alphanumerics and graphics to the printer*

**Model I/III, 16K and up**

**Ron Goodman, North Hollywood, CA**

The big computer systems are blessed with a wonderful button. It is off to the side of the keyboard, and is called the "screen print" button. Its function is to print the entire screen onto a printer so that you can have a hard copy.

The TRS-80 doesn't have such a button. Besides, many printers don't print the graphics that might be on the screen of a TRS-80. The most popular TRS-80 printer, the Epson MX-80, can print the graphics that are on the TRS-80s screen. By using the program presented here with an MX-80, you can have the advantage of a screen print button.

**When Can the Program Work?**

Just about any time that the BREAK key returns you to the READY mode, this program will work. If you are in the READY mode, it will work. It will work while running most BASIC programs. (Exceptions to this are BASIC programs that disable the BREAK key.) It can work during an INPUT command, in the SYSTEM mode, or at any time during the running of a program.

Few assembly language programs will allow this program to work. Putting a CALL 16396 or CALL START (where START = the starting address of the screen print routine) in the main driver of an assembly language program, will, in many cases, enable the screen print key.

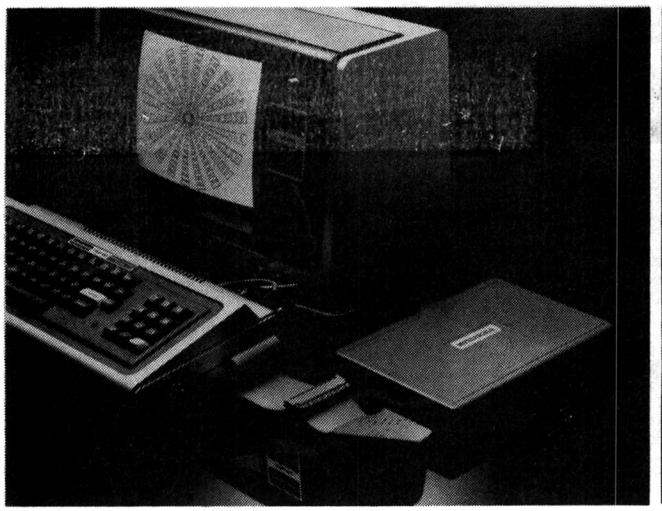
Enter the program from Editor Assembler or from TBUG, and create a system tape. The program is located directly over the disk command area. If you have disk capability, you will have to use an editor assembler and change the value in line 180 to a high address. Change it to 7FB9H for 16K, BFB9H for 32K, or FFB9H for 48K. You must also set memory size to 32696 for 16K, 49080 for 32K, or 65465 for 48K.

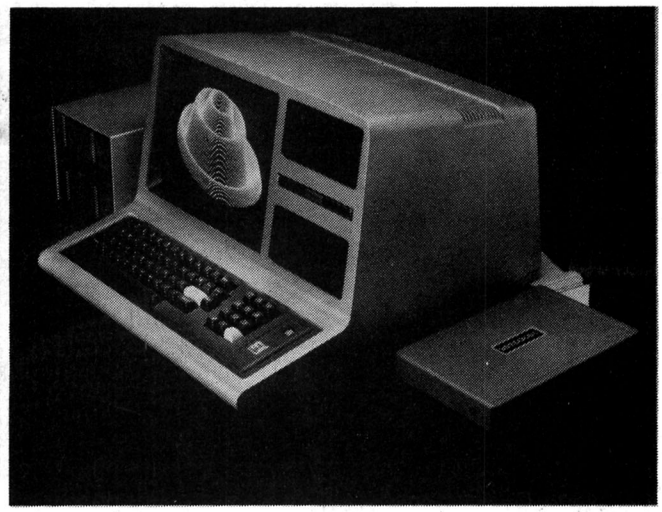
When the program is loaded, the screen print key is automatically active. Press the SHIFT key and the BREAK key. If your printer was ready, whatever is on your screen will soon be on paper from your printer. If it wasn't ready, don't worry. The screen print program will be in a loop until your printer is ready. If, while printing, you decide to stop the printout, just press ENTER and control will be returned to BASIC.

This program should work for other printers, but unless the printer's graphics codes are like those on the EPSON MX-80, graphics won't turn out. On the MX-80, the graphics codes are different from TRS-80's codes. A code can be converted by adding 32 to the TRS-80 code. This program handles that automatically.

Notice that cassette users don't need to answer the memory size question. This is because the program resides in memory that is normally not used. In a sense, this program does not require any memory. At least, you will not miss the memory that it does use.

# TURN YOUR COMPUTER INTO A GRAPHICS MACHINE





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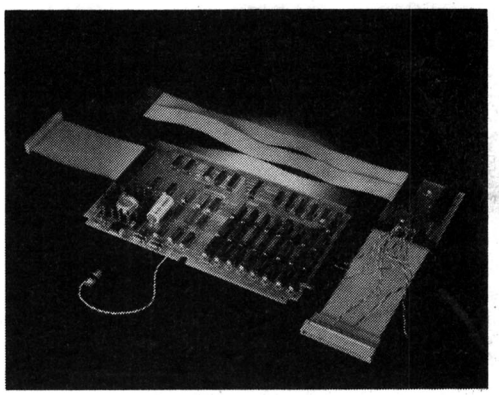

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Circle # 19

**Program Listing for**
**Screen Printing with MX-80**

```
                00100 ; THIS ROUTINE PROVIDES A SCREEN PRINT BUTTON.
                00110 ; BY PRESSING THE SHIFT KEY AND THE BREAK KEY,
                00120 ; THIS ROUTINE WILL PRINT THE CONTENTS OF THE
                00130 ; SCREEN ONTO AN EPSON MX-80 PRINTER. THIS
                00140 ; SHOULD WORK ON MOST OTHER PRINTERS, AS LONG AS
                00150 ; THERE ARE NO GRAPHICS ON THE SCREEN.
400C            00160          ORG     16396          ; BREAK ENTRY POINT
400C C35241     00170          JP      START          ; CALL ROUTINE
4152            00180          ORG     4152H          ; START OF SCREEN-PRINT
4152 3A8038     00190 START    LD      A,(14464)      ; GET BYTE FOR SHIFT KEY
4155 B7         00200          OR      A              ; CHECK FOR ZERO
4156 2002       00210          JR      NZ,BEG         ;PRINT SCREEN IF <>0
4158 3C         00220          INC     A              ; RESTORE A REGISTER
4159 C9         00230          RET                    ;RETURN CONTROL TO ROM
415A E5         00240 BEG      PUSH    HL             ; SAVE HL
415B D5         00250          PUSH    DE             ; SAVE DE
415C C5         00260          PUSH    BC             ; SAVE BC
415D 21E837     00270          LD      HL,14312       ; LINE PRINTER ADDRESS
4160 CD8C41     00280          CALL    READY          ; WAIT FOR PRINTER
4163 360F       00290          LD      (HL),15        ; SEND TO PRINTER
4165 0610       00300          LD      B,16           ; # LINES ON SCREEN
4167 11003C     00310          LD      DE,15360       ; START ADDRESS OF SCREEN
416A CD8C41     00320 LOOP2    CALL    READY          ; WAIT FOR PRINTER
416D 360E       00330          LD      (HL),14        ; EXPANDED CHARACTER CODE
416F 0E40       00340          LD      C,64           ; CHARACTERS PER LINE
4171 CD8C41     00350 LOOP1    CALL    READY          ; WAIT FOR PRINTER
4174 1A         00360          LD      A,(DE)         ; GET BYTE OFF SCREEN
4175 CB7F       00370          BIT     7,A            ; CHECK IF GRAPHICS
4177 2802       00380          JR      Z,NOGRFC       ; GO ON IF NOT GRAPHICS
4179 C620       00390          ADD     A,32           ; CONVERT CHR$ TO MX-80
417B 77         00400 NOGRFC   LD      (HL),A         ; SEND TO PRINTER
417C 13         00410          INC     DE             ; NEXT SCREEN POSITION
417D 0D         00420          DEC     C              ; DEC CHR/LINE COUNT
417E 20F1       00430          JR      NZ,LOOP1       ; NEXT CHR IF NOT ENDLINE
4180 CD8C41     00440          CALL    READY          ; WAIT FOR PRINTER
4183 360D       00450          LD      (HL),13        ; TELL PRINTER TO DO LINE
4185 10E3       00460          DJNZ    LOOP2          ; PRINT NEXT LINE IF MORE
4187 C1         00470 BASIC    POP     BC             ; RESTORE BC
4188 D1         00480          POP     DE             ; RESTORE DE
4189 E1         00490          POP     HL             ; RESTORE HL
418A AF         00500          XOR     A              ; CANCEL BREAK KEY
418B C9         00510          RET                    ; PASS CONTROL BACK TO ROM
                00520 ; ROUTINE TO CHECK WHETHER PRINTER IS READY OR NOT. THE
                00530 ; LEFTMOST BIT OF THE CONTENTS OF 14312 EQUALS 1 IF NOT
                00540 ; READY, AND 0 IF THE PRINTER IS READY.
418C CB7E       00550 READY    BIT     7,(HL)         ; CHECK BIT STATUS
418E C8         00560          RET     Z              ; PRINTER READY, RETURN
418F 3A4038     00570          LD      A,(14400)      ; TAKE ENTER KEY STATUS
4192 FE01       00580          CP      1              ; IS ENTER BEING PRESSED?
4194 20F6       00590          JR      NZ,READY       ; IF NOT THEN LOOP
4196 C1         00600          POP     BC             ; THEN REMOVE CALL ADDRESS
4197 18EE       00610          JR      BASIC
0000            00620          END
00000 TOTAL ERRORS
```

■

# FORTRESS

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# The Scott Adams Adventure Series
## AN OVERVIEW

*I stood at the bottom of a deep chasm. Cool air sliding down the sides of the crevasse hit waves of heat rising from a stream of bubbling lava and formed a mist over the sluggish flow. Through the swirling clouds I caught glimpses of two ledges high above me: one was bricked, the other appeared to lead to the throne room I had been seeking.*

*A blast of fresh air cleared the mist near my feet and like a single gravestone a broken sign appeared momentarily. A dull gleam of gold showed at the base of the sign before being swallowed up by the fog again. From the distance came the angry buzz of the killer bees. Could I avoid their lethal stings as I had managed to escape the wrath of the dragon? Reading the sign might give me a clue to the dangers of this pit.*

*I approached the sign slowly.*

And so it goes, hour after hour, as you guide your microcomputer through the Adventures of Scott Adams in an effort to amass treasures within the worlds of his imagination.

By definition, an adventure is a dangerous or risky undertaking; a novel, exciting, or otherwise remarkable event or experience. On your personal computer, Adventure is that and more.

For the user, playing Adventure is a dangerous or risky undertaking in that you better be prepared to spend many addictive hours at the keyboard. If you like challenges, surprises, humor and being transported to other worlds, these are the games for you. If you dislike being forced to use your common sense and imagination, or you frustrate easily, try them anyway.

In beginning any Adventure, you will find yourself in a specific location: a forest, on board a small spaceship, outside a fun house, in the briefing room of a nuclear plant, in a desert, etc.

By using two-word commands you move from location to location, manipulate objects that you find in the different places, and perform actions as if you were really there. The object of a game is to amass treasure for points or accomplish some other goal. Successfully completing a game, however, is far easier to state than achieve. In many cases you will find a treasure but be unable to take it until you are carrying the right combination of objects you find in the various locations.

How do you know which objects you need? Trial and error, logic and imagination. Each time you try some action, you learn a little more about the game. Which brings us to the term "game" again. While called games, Adventures are actually puzzles because you have to discover which way the pieces (actions, manipulations, use of magic words, etc.) fit together in order to gather your treasures or accomplish the mission. Like a puzzle, there are a number of ways to fit the pieces together; players who have found and stored all the treasures (there are 13) of Adventure #1 may have done so in different ways.

In finding how the pieces fit, you will be forced to deal with unexpected events, apparent dead ends and Scott's humor, which is one of the best parts of the puzzles.

If you run into a barrier like not being able to discover more rooms, don't give up. Play the game with some friends; sometimes they'll think of things you haven't tried.

*While I pondered how to reach the throne room — which I was sure contained the treasures of Croesus — the fog grew thicker and the hours passed. I realized I would not be able to outwit Adams today...but maybe tomorrow. I marked my present location on my tattered map and began the long trip to the surface. As I dragged myself off to bed, I thought about other possible Adventures.*

*But enough for tonight. Tomorrow — another crack at the chasm.* —by Ken Mazur

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Circle # 22

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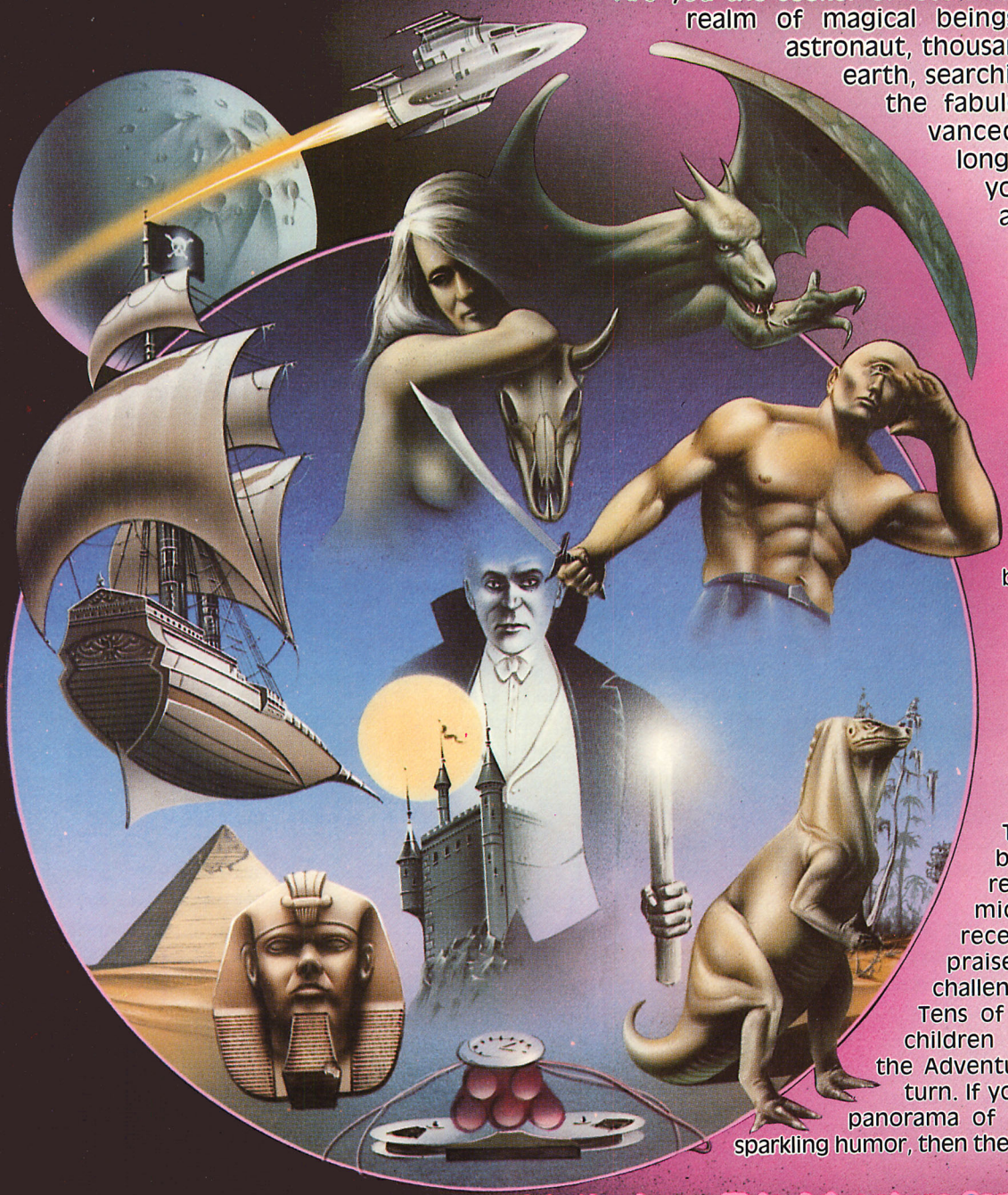

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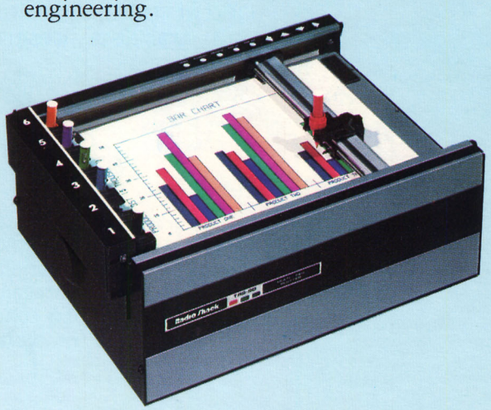

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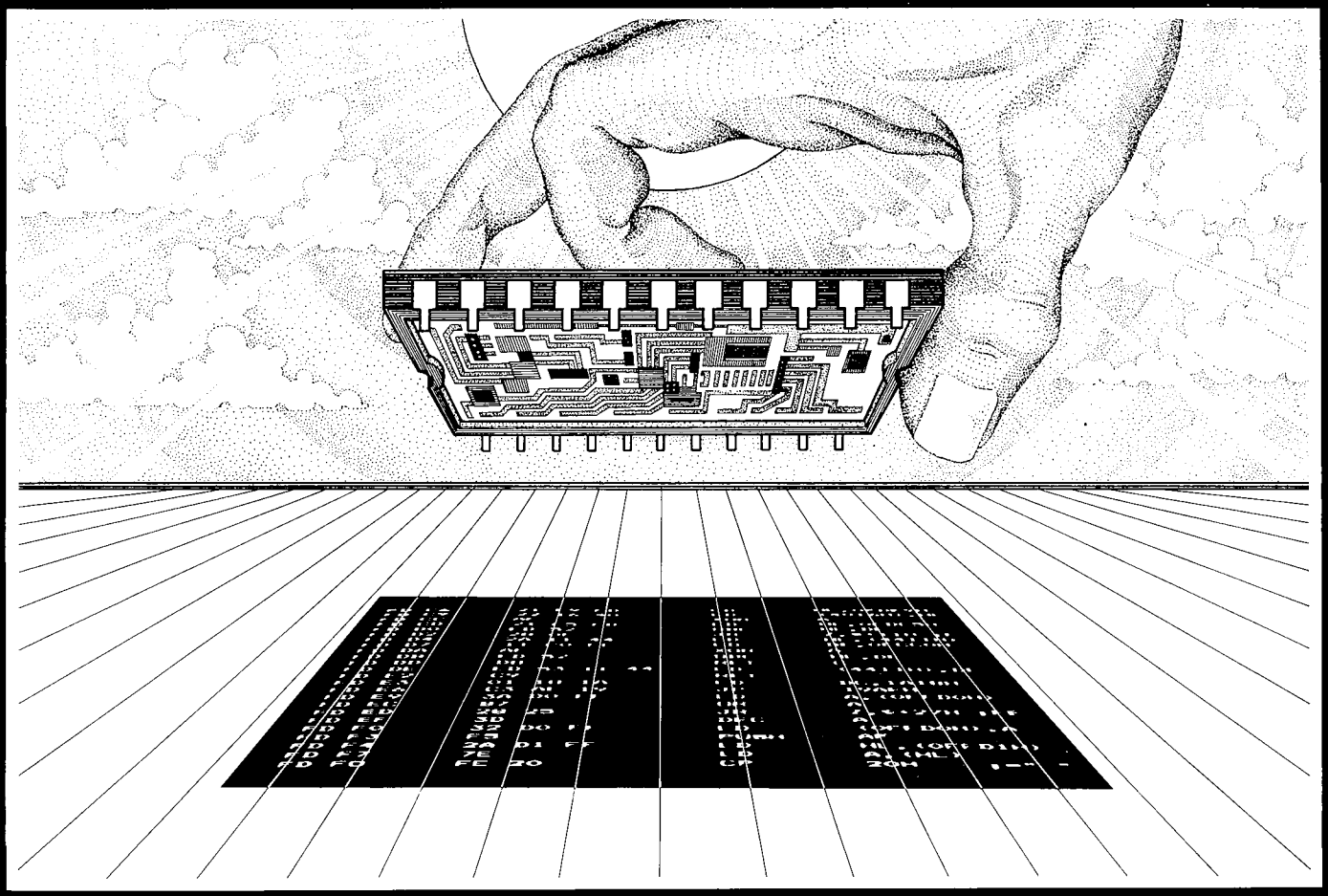

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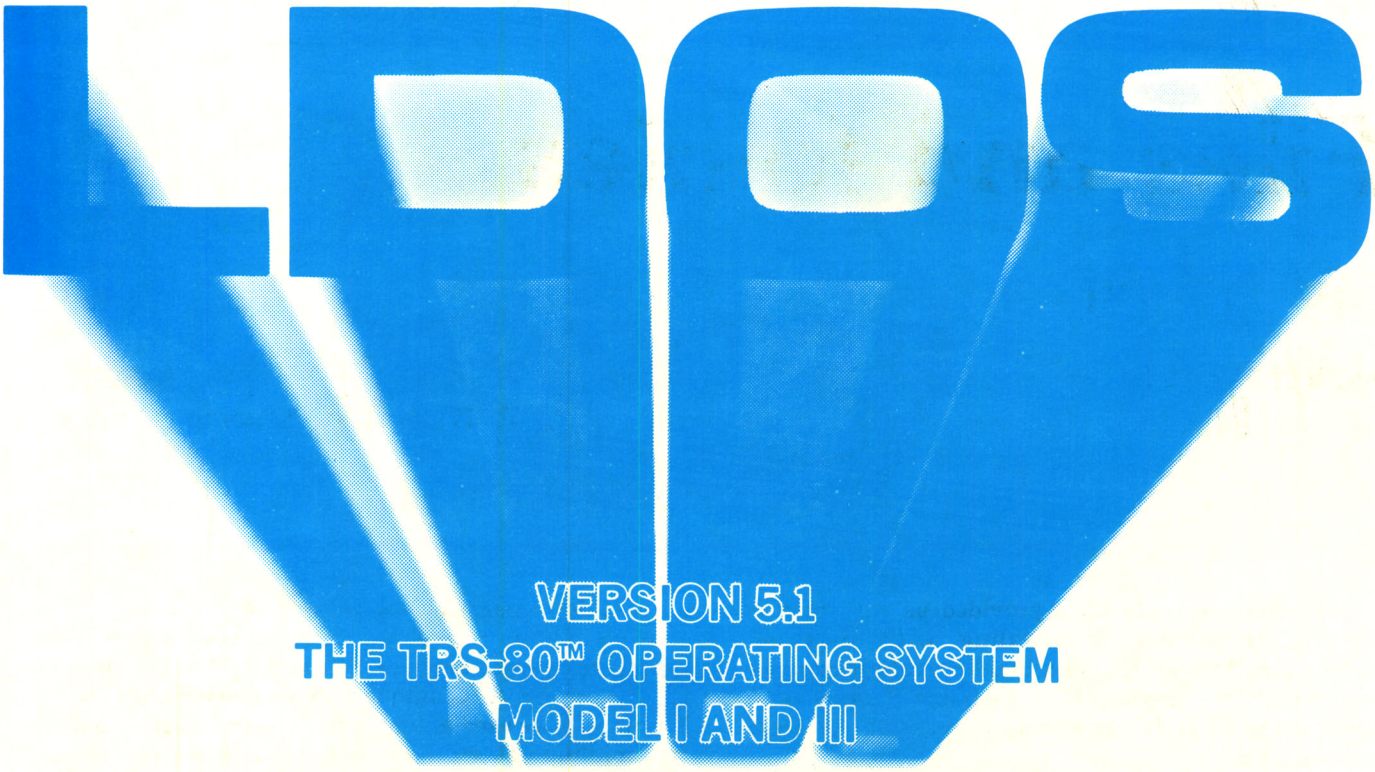


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# Files and foibles

## *List linking*

**Model I, II and III**

T. R. Dettmann, Associate editor

Computer scientists have provided us with many powerful techniques for dealing with files of information. Whole courses are taught in college on how to do this ("data structures" is the name of the topic). One of the most useful techniques, and one of the most common, is the linked list.

Richard Straw covered list linking techniques in the January 1982 issue for lists in memory. He indicated, however, that list linking was not very useful for disk files because of the "thrashing" that the disk will go through.

As a general rule, he is quite right. In the worst cases, a linked list can exist in such a way as to really give the disk drive a workout trying to access the records. However, there are still cases where list linking is not only useful, but very efficient for controlling disk files. Linked list techniques are also closely related to other structuring techniques which make random disk files much more efficient.

As an example of where a linked list can be useful, let's consider a job costing system which includes a variable number of job functions, from zero through 99, depending upon the job. If we set this up as a random access file, we could fix it so that every job has space for 99 functions, whether it uses them or not.

This is efficient from the standpoint of access to the functions, but unless most jobs have 99 functions, it will be a big waste of disk space. Let's say the average job has five functions, a few jobs have none or 10, and only a very few have greater than 10. In this case, we could improve our efficiency by setting up each job with enough space for five functions when it is created.

So what happens when we need more functions? A simple approach is to start another record, store five more functions there, and link it to the first with the linked list technique. Most jobs will have, at most, one link. Many jobs will have none. Only a few jobs will have to link together more than two records.

Efficient storage is a major problem. List linking can help. List linking can also be a real problem. Aside from the problem of "thrashing", which is very real, we can also get into problems if we don't want to access our list in the order naturally provided by the links.

In our job costing example, we could always bring all job functions into memory when we need to work on the job. It is a simple technique and well worth the effort. But what if we used a linked list to store a mailing list? In a mailing list, we may want to retrieve everyone in alphabetical order. If we link every record into an alphabetical list, we can just follow the links and get everyone. But what if we want to change just one record?

In order to change one record in the file, we first have to find it. To find it, we search through the list starting with the first record. The one we want to change might be "Markson." It could even be stored in record number one in our file, but with a linked list, we wouldn't find it until we searched through the whole list up to that point. This is where thrashing becomes a problem. Let's see how a linked list works to see why this is so.

### How it works

A linked list works by having each item in the list include a "pointer" which points to the next item in the list. This pointer is nothing but the disk address — the record number of the item. Figure 1 shows a simple list which is linked in numerical order.

The big advantage of the linked list is that it can add new items anywhere in the file and yet still have them recovered in a predetermined order. As with everything else in computers, you do not get something for nothing. In order to get convenience of retrieval, you have to store extra data (the pointers) and you have to take extra time to get it ready. Still, in some cases, it is worth it.

### A simple example

To show list linking in a form other than that used in the January 1982 issue, let's consider this problem. Assume that we want to maintain a "To/Do" list (one of my favorite problems.) However, we want to maintain it on a monthly basis, with entries for each day we have something to do.

We could make a big list and sort it by day, but let's try something else. We will put a master pointer for each

Figure 1
A sample linked list.
Follow the arrows to follow the links.

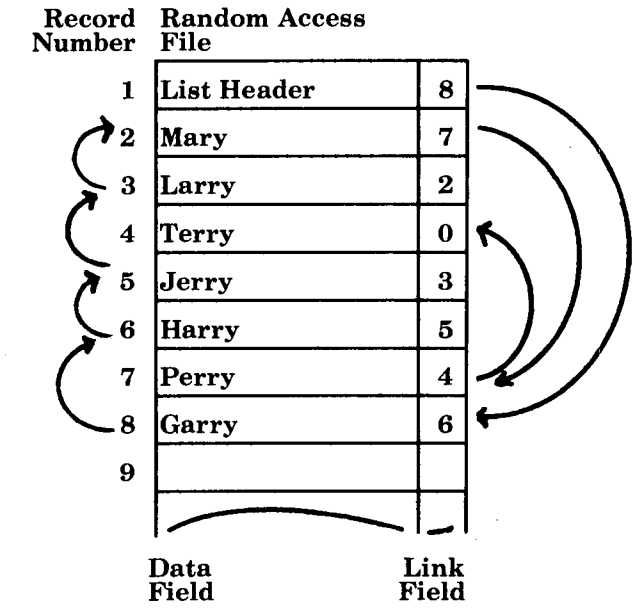
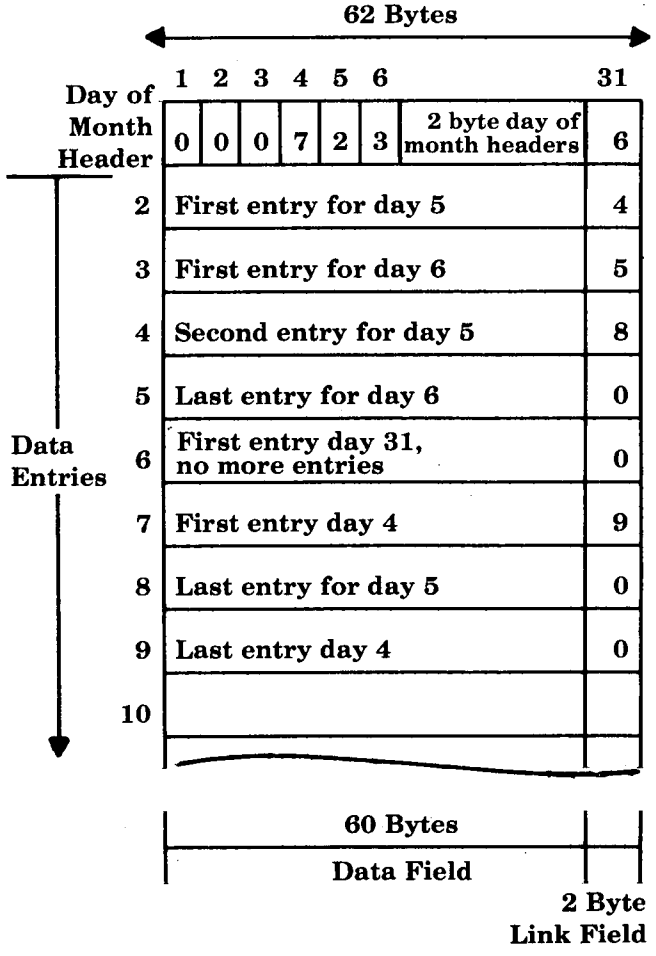



Figure 2

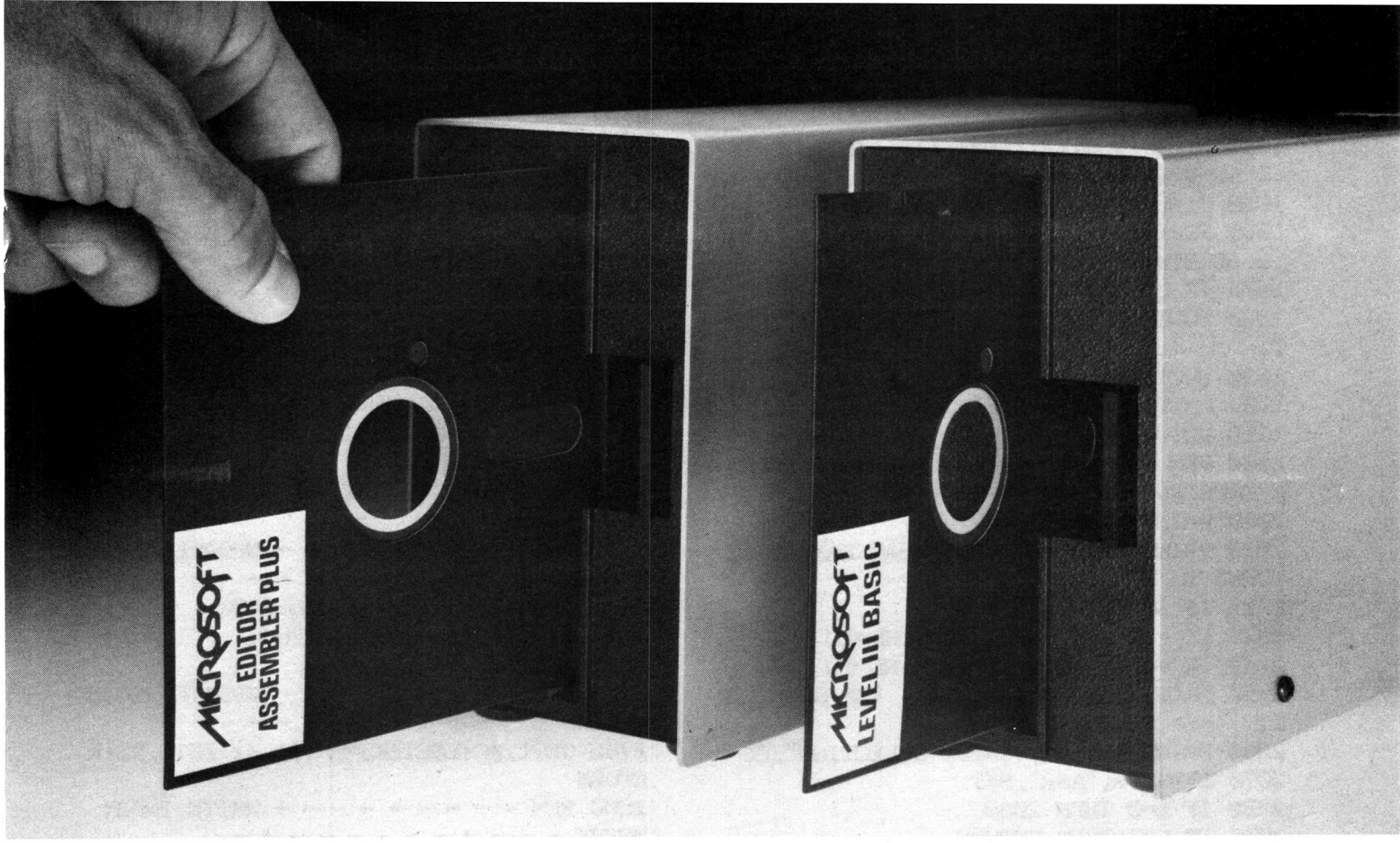



day of the month in the first record of a file. This pointer will point to (or remember) the beginning of a list of items to do. We will also store a pointer which points to the last item in each day's list(see figure 2).We will use this to simplify adding new things to the list.

As we add to the list, we put the item in the first available space and then add it to the end of the appropriate day's list. When ready to print out a list for a given day, we simply follow the threads, printing each item as we get to it.

While thrashing is a problem, we would almost have to work at it to make it a serious one. The program listing included here illustrates a simple solution to the problem.

```
10 REM**********************************
**********************************
20 REM
30 REM  SIMPLE LIST LINKING
40 REM
50 REM  TERRY R. DETTMANN
60 REM  VERSION 1.0      01/30/82
70 REM
80 REM  FILENAME: LISTS/BAS
90 REM
100 REM*********************************
**********************************
110 CLEAR10000:DEFINTA-Z
120 DIM DT$(31),STK$(31)
200 REM - - - - - - - - - MENU - - - - -
- - - - - - - - - - - - - - - - -
210 CLS:PRINT"MONTHLY TODO LISTS":PRINT
:PRINT
220 PRINTTAB(10)"0.  END"
230 PRINTTAB(10)"1.  GET NEW MONTH"
240 PRINTTAB(10)"2.  ADD/EDIT/DELETE EN
TRIES"
250 PRINTTAB(10)"3.  PRINT DAY'S ENTRIE
S"
300 REM          SELECTION
310 PRINT:PRINT:PRINT
320 PRINTTAB(10);:INPUT"SELECTION";S
330 IF S=0 THEN CLOSE:CLS:END
340 IF S<1 OR S>3 THEN 320
350 ON S GOSUB 1000,2000,3000
360 GOTO200
500 REM - - - - - - - - - GET A KEY - - -
 - - - - - - - - - - - - - - - -
510 C$=INKEY$:IF C$=""THEN510 ELSE RETU
RN
600 REM - - - - - - - - - DELAY ROUTINE -
 - - - - - - - - - - - - - - -
610 FORTM=1TO500:NEXTTM:RETURN
1000 REM - - - - - - - - - GET A NEW MONT
H - - - - - - - - - - - - - - - -
1010 CLOSE:PRINT
1020 PRINTTAB(10);:LINE INPUT"MONTH: ";
MN$
1030 FF$=MID$(MN$,1,3)+"/DAT"
```

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Circle # 20

```
1040 OPEN"R",1,FF$,62
1050 FORI=1TO31:FIELD#1,(I-1)*2 AS DMY$
,2 AS DT$(I):NEXTI
1060 FIELD#1,60 AS IT$,2 AS LK$
1065 FORI=1TO31:FIELD#1,(I-1)*2 AS DMY$
,2 AS STK$(I):NEXTI
1070 IF LOF(1)<>0 THEN RETURN
1080 FORI=1TO31:LSET DT$(I)=MKI$(0):NEX
TI
1090 PUT1,1:PUT1,2
1100 LSETSTK$(1)=MKI$(1):PUT1,3
1110 RETURN
2000 REM - - - - - - - - - ADD/EDIT/DELET
E ENTRIES - - - - - - - - - - -
2010 PRINT
2020 PRINTTAB(10);:INPUT"WHAT DAY (0 RE
TURNS TO MENU)";DY
2025 IF DY=0 THEN RETURN
2030 IX = 2*DY-1:GOSUB2500:HD=ID
2040 IX = IX + 1:GOSUB2500:ND=ID
2050 PRINTTAB(10)"<A> ADD    <S> SCAN/ED
IT    <R> RETURN"
2060 PRINTTAB(10);:INPUT"SELECTION";S$
2070 L=INSTR("ASR",S$)
2080 IF L=0 THEN 2060
2085 IF L=3 THEN RETURN
2090 ON L GOSUB 2100,2200
2095 GOTO2000
2100 REM - - - - - - - - - - ADD ENTRIES
- - - - - - - - - - - - - - - - -
2110 PRINTTAB(10);:LINE INPUT"ENTRY: ";
EN$
2120 GOSUB2550:LSETIT$=EN$:PUT1,LC
2130 GOSUB2600
2140 RETURN
2200 REM - - - - - - - - - - EDIT/SCAN EN
TRIES - - - - - - - - - - - - - -
2210 IF HD=0 THEN PRINT"NO ENTRIES":GOS
UB600:RETURN
2220 LK=HD:LP=0
2230 IF LK=0 THEN RETURN
2240     GET1,LK
2250     PRINT IT$
2260     INPUT"ACCEPT (Y/N)";YN$
2270     IF YN$="Y" THEN LP=LK:LK=CVI(LK
$):GOTO2230
2280     IF YN$<>"N" THEN 2260
2290     PRINTTAB(10);:LINE INPUT"NEW EN
TRY: ";NE$
2300     IF NE$="DELETE" THEN GOSUB2900:
GOTO2230
2310     LSET IT$=NE$:PUT1,LK
2320     LP=LK:LK=CVI(LK$):GOTO2230
2500 REM - - - - - - - - - - GET INDEX EN
TRY - - - - - - - - - - - - - - -
2510 IF IX>31 THEN GET1,2:N=IX-31 ELSE
GET1,1:N=IX
2520 ID=CVI(DT$(N)):RETURN
2550 REM - - - - - - - - - - GET FREE SPA
CE - - - - - - - - - - - - - - - -
2560 GET1,3:SP=CVI(STK$(1))
2570 IF SP<=1 THEN LC=LOF(1)+1:RETURN
2580 LC=CVI(STK$(SP)):SP=SP-1:LSETSTK$(
1)=MKI$(SP):PUT1,3
2590 RETURN
2600 REM - - - - - - - - - - LINK INTO LI
ST - - - - - - - - - - - - - - -
2610 IF HD=0 THEN HD=LC:ND=LC:GOSUB2700
:LK=0:RC=LC:GOSUB2750:RETURN
2620 RC=ND:ND=LC:GOSUB2700
2630 LK=LC:GOSUB2750
2640 LK=0:RC=LC:GOSUB2750
2650 RETURN
2700 REM - - - - - - - - - - UPDATE MASTE
R POINTERS - - - - - - - - - - -
2710 IX=2*DY-1:ID=HD:GOSUB2800
2720 IX=IX+1:ID=ND:GOSUB2800
2730 RETURN
2750 REM - - - - - - - - - - UPDATE RECOR
D LINK - - - - - - - - - - - -
2760 GET1,RC:LSETLK$=MKI$(LK):PUT1,RC:R
ETURN
2800 REM - - - - - - - - - - WRITE INDEX
ENTRY - - - - - - - - - - - - -
2810 IF IX>31 THEN RD=2:GET1,2:N=IX-31
ELSE RD=1:GET1,1:N=IX
2820 LSETDT$(N)=MKI$(ID):PUT1,RD:RETURN
2900 REM - - - - - - - - - - DELETE ENTRY
 - - - - - - - - - - - - - - - -
2910 L1=LP:L2=LK:L3=CVI(LK$)
2920 IF L1=0 THEN HD=L3:GOSUB2700
2930 IF L3=0 THEN ND=L1:GOSUB2700
2935 IF L1=0 THEN 2950
2940 RC=L1:LK=L3:GOSUB2750
2950 GOSUB2960:LK=L3:RETURN
2960 REM - - - - - - - - - - PUSH DELETED
 RECORD ON STACK - - - - - - - -
2970 GET1,3:SP=CVI(STK$(1))
2980 IF SP>=31 THEN RETURN
2990 SP=SP+1:LSETSTK$(SP)=MKI$(L2):LSET
STK$(1)=MKI$(SP):PUT1,3:RETURN
3000 REM - - - - - - - - - PRINT DAY'S EN
TRIES - - - - - - - - - - - - - -
3010 PRINT:PRINTTAB(10);:INPUT"DAY";DY
3020 IX=2*DY-1:GOSUB2500:HD=ID
3030 IF HD=0 THEN PRINT"NO ENTRIES":GOT
O3100
3040 LK=HD
3050 IF LK=0 THEN 3100
3060     GET1,LK:PRINTTAB(10)IT$
3070     LK=CVI(LK$):GOTO3050
3100 PRINT"----------PRESS ENTER TO RET
URN----------"
3110 GOSUB500:IF ASC(C$)=13 THEN RETURN
 ELSE 3110
60000 SAVE"LISTS/BAS"
```

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Circle # 26

# Base conversions with the Pocket Computer

Pocket Computer

Peter G. Savard, Livonia, NY

For a person such as myself, one who gave up serious math at an early age, converting from decimal to hex and back can be a real chore. Shortly after I purchased my Model I, I wrote a program to do these conversions for me.

However, I soon found that no matter how many conversions I did before I loaded the program I was working on, there was always one more conversion I needed to make when my conversion program was not available. So, back to pencil and paper. Enter the Pocket Computer.

What application could I put this nifty little gadget to? Why not hex to decimal (and decimal to hex) conversion? In fact, why not a program which would do several of the little chores that a programmer needs to do. The program in Listing 1 is the result.

When you have entered the program, put the computer in the DEF mode and press SHIFT and SPACE. A menu listing the program options will be displayed. The options are: HEX —>DEC — SHIFT H

Selecting this option causes ENTER HEX # to be displayed followed by ?#. Because there are no string functions in this BASIC, the digits of the hex number must be entered one at a time (four digits must be entered, e.g., 732A or 004F). After the last digit is entered, the program will process the number and beep to let you know it is doing something. In a few seconds, the decimal equivalent will be displayed. Press ENTER and you can do another number.

DEC —> HEX — SHIFT D. The same process is followed in this section with the exception that the decimal number can be entered at once. Press ENTER and the program will process the number and display the hex equivalent with leading zeros.

POKE —> PRINT — SHIFT S. With this option, you are prompted to enter the POKE address. The PRINT@ value of that address will be displayed.

PRINT —> POKE - SHIFT F. This is just the opposite. Enter the PRINT@ address and the POKE value of that address will be displayed.

POKE >32767—SHIFT G. Enter the value of address to be poked and the correct value to be poked will be displayed.

Although these are fairly simple calculations, I have found them to be a great time saver. I hope others find them that way also. Besides, it will give you something to do with your Pocket Computer.

**Program Listing for Base Conversions**

```
14 :"D":CLEAR :BEEP 1: INPUT"ENTER DEC
  # -> ";D:I=19
15 :PAUSE "PROCESSING"
16 :A=INT (D/4Ø96):GOSUB 15Ø:D=D-4Ø96*A
  :BEEP 1
18 :A=INT (D/256):GOSUB 15Ø:D=D-256*A:B
  EEP 1
2Ø :A=INT (D/16):GOSUB 15Ø:D=D-16*A:BEE
  P 1
22 :A=INT (D):GOSUB 15Ø:BEEP 1
24 :PRINT "HEX # =>";A$(2Ø);A$(21);A$(2
  2);A$(23)
26 :GOSUB14
1ØØ :"H":CLEAR :BEEP 1:PAUSE "ENTER HEX
   #"
1Ø2 :INPUT A$(2Ø),A$(21),A$(22),A$(23):
  PAUSE"PROCESSING":FOR I=2 TO 5:BEEP 1
  :A$=A$(18+I):GOSUB 399:NEXT I
```

```
105 :N=0:N=N+4096*A(2)+256*A(3)+16*A(4)
  +1*A(5)
106 :PRINT "DEC # => ";N
107 :GOTO 10
150 :I=I+1
151 :IF A=0LET A$(I)="0"
152 :IF A=1LET A$(I)="1"
153 :IF A=2LET A$(I)="2"
154 :IF A=3LET A$(I)="3"
155 :IF A=4LET A$(I)="4"
156 :IF A=5LET A$(I)="5"
157 :IF A=6LET A$(I)="6"
158 :IF A=7LET A$(I)="7"
159 :IF A=8LET A$(I)="8"
160 :IF A=9LET A$(I)="9"
161 :IF A=10LET A$(I)="A"
162 :IF A=11LET A$(I)="B"
163 :IF A=12LET A$(I)="C"
164 :IF A=13LET A$(I)="D"
165 :IF A=14LET A$(I)="E"
166 :IF A=15LET A$(I)="F"
167 :RETURN
399 :IF A$="0"LET A(I)=0
400 :IF A$="1"LET A(I)=1
401 :IF A$="2"LET A(I)=2
402 :IF A$="4"LET A(I)=4
403 :IF A$="5"LET A(I)=5
404 :IF A$="6"LET A(I)=6
405 :IF A$="7"LET A(I)=7
406 :IF A$="8"LET A(I)=8
407 :IF A$="9"LET A(I)=9
409 :IF A$="A"LET A(I)=10
410 :IF A$="B"LET A(I)=11
411 :IF A$="C"LET A(I)=12
412 :IF A$="D"LET A(I)=13
413 :IF A$="E"LET A(I)=14
414 :IF A$="F"LET A(I)=15
415 :RETURN
500 :"S":CLEAR :PAUSE "POKE=>PRINT"
510 :INPUT"POKE ADD? ";P:P=P-15360:BEEP
   1:PRINT "PRINT ADD = ";P:GOTO510
600 :"F":CLEAR :PAUSE "PRINT=>POKE
610 :INPUT "PRINT ADD? ";P:P=P+15360:BE
  EP 1:PRINT "POKE ADD=";P:GOTO610
700 :"G":CLEAR :PAUSE "POKE ABOVE 32767
  "
710 :INPUT"ADDRESS = ? ";P:BEEP 1:P=-1*
  (65536-P):PRINT"ADDRESS = ";P:GOTO 71
  0
800 : " ":BEEP 1:PAUSE "PROGRAMING UTIL
  ITIES"
810 :PRINT "HEX => DEC - SHIFT H"
812 :PRINT "DEC => HEX - SHIFT D"
815 :PRINT "POKE => PRINT - SHIFT S"
820 :PRINT "PRINT => POKE - SHIFT F"
830 :PRINT "POKE > 32767 - SHIFT G"
840 :GOTO 800
```

■


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# GOSUB-RETURN

## *How subroutines work*

**Model I, II and III**

T. R. Dettmann, Associate editor

So far in this series we have covered some simple things you can do in BASIC with a few limited statement types, but we have been limited primarily by programming technique. Just knowing the statements in BASIC isn't going to make good programs for you. You have to know how to use them.

One of the most important advances in programming came with the concepts of Modular and Structured programming. Don't worry, we aren't going to get all technical about just what these terms mean. What we will do is work out some practical techniques for programming based on the principles these techniques imply.

First, let's talk a little philosophy. Just what do we mean by "modular programming?"

### What Is Modular Programming?

Writing computer programs is a fascinating hobby (and even *more* fascinating job). If you think about it, you will notice that computer programming is really nothing more than problem solving. Most computer programming courses fail to understand that and concentrate instead on the mechanics of a particular programming language.

The most significant activity in programming is the design of the problem solution: working it out in such a way that it can be programmed on a computer. If we look at programming as problem solving, then it seems obvious that techniques we learned back in school for solving problems should also work for writing programs.

One of the very earliest techniques we all learned was that if you were faced with a *big* problem, it is better to break it into a number of smaller problems, and then solve each of those in turn. Solving all of the smaller problems adds up to a solution of the big one.

If the smaller problems are still too large to solve easily, we can break each of them down into still smaller ones. In programming, we call this "modularization." Modular programming involves nothing more than this technique of breaking a problem into small pieces. Each piece has a "module" of the program dedicated to solving its part of the problem.

### Subroutines

Instead of writing several modules and threading them one after another to solve a problem, it's simpler if we can invent a "black box" that solves a problem and returns the solution to wherever we called it from.

BASIC provides a number of built-in functions like the SIN and COS functions that operate that way. We don't have to know how they work. All we have to know is that by feeding them a number, we get back another number.

The key point here, is the ability to provide similar functions without having to know how they work inside. A subroutine is a way to write the same thing in BASIC.

A simple example of a frequently used routine in programs is a dead time loop. It is a short FOR...NEXT loop that does nothing but kill a few seconds of time whenever such time is needed. A dead time loop might look like this:

```
FOR TM=1 TO 500: NEXT TM
```

Many programs use loops like this repeatedly. We could write loops everywhere we wanted them, but if we design a single module to do this, we would be able to call it from any point without having to remember where we are. BASIC does this with the GOSUB statement.

### GOSUB-RETURN

When we have a module, like the dead time loop, that we want to use at some place in the program, we can tell the program to execute and remember where it is by using a GOSUB. If the dead time loop is at line 500, we can run it by saying:

```
GOSUB 500
```

When BASIC executes the

GOSUB, it remembers where the program is, then it jumps to the subroutine and executes that. In order to get back to where we were in the program, we end the subroutine with the "RETURN" statement. This tells BASIC to go back to the place where the subroutine was called and continue the program from just after the GOSUB statement.

To get a feeling for how this works, look at the sample program. We have defined a number of subroutines which print out their designation when they are executed. Several even call other subroutines. The program also turns on the trace feature of BASIC (TRON), which causes each line's line number to be printed on the screen as the line is reached for execution.

Type and run the program, then make a list of each line number and print statement as they are reached. Use a listing of the program to follow its execution. This should help you see how the GOSUB actually remembers where it was last. In fact, it can even remember when one subroutine calls another.

**Program to illustrate GOSUB**

```
 10 REM
 20 TRON
 30 GOSUB 300
 40 GOSUB 100
 50 GOSUB 200
 60 TROFF
 70 END
100 REM SUBROUTINE 1
110 PRINT "SUBR 1"
120 RETURN
200 REM SUBROUTINE 2
210 PRINT "SUBR 2"
220 RETURN
300 REM SUBROUTINE 3
310 PRINT "SUBR 3"
320 GOSUB 400
330 RETURN
400 REM SUBROUTINE 4
410 PRINT "SUBR 4"
420 GOSUB 500
430 GOSUB 600
440 RETURN
500 REM SUBROUTINE 5
510 PRINT "SUBR 5"
520 RETURN
600 REM SUBROUTINE 6
610 PRINT "SUBR 6"
620 RETURN ■
```


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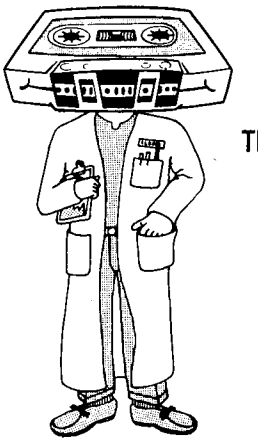

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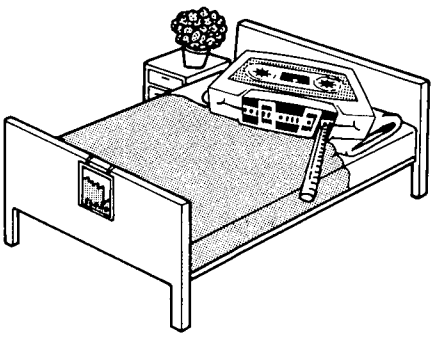

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**Circle # 29**

# Spaceship Orbitor

## A realistic orbital mechanics simulation with graphics

**Model I/III, 16K and up**

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Are you tired of the ordinary "Lunar Lander" and want to try something a little more realistic? Do you want to actually learn something about orbital mechanics? Then try this program!

### Program Organization

This program is intended to give an accurate simulation of the action of a spaceship in orbit. To do this, it is necessary to calculate true inverse square-law gravity. This means that the acceleration of gravity is proportional to the mass of the primary divided by the square of the distance from the spaceship to the center of the primary. Since the effect of gravity during the whole segment must be simulated, the effective position of the ship for the entire segment is taken to be the center point of the segment. This position is estimated by projecting the ship's velocity ahead for one-half of the segment time, then since this position would always lie outside of the true orbit, making a further correction.

If the rocket engine of the spaceship produces a constant thrust, the resulting acceleration will increase as the fuel is burned and the total mass of the ship decreases. This effect is accurately simulated in this program by using the correct logarithmic equation for the velocity change due to the rocket burn.

The position of the spaceship is most conveniently calculated and stored in terms of its X and Y coordinates, with the center of the primary as the origin. Likewise, the spaceship's velocity is used as X and Y vectors. Both position and velocity are maintained in double precision form, necessary for a smooth landing. Since normally there is little change for each segment, the updating of velocity for gravity and for rocket burns is calculated in single precision. The accuracy of this approach is good; over one complete orbit, the calculated position of the ship remains within a couple of meters of its theoretical position.

The impact of the spaceship with the surface of the primary will normally occur during one of the calculation segments; the impact conditions are then interpolated from the segment-end conditions immediately before and after impact.

All user entries and program displays are in polar coordinates (direction and magnitude), which are easier to visualize than the X, Y coordinates used for calculations. Keep in mind that all directions are expressed in degrees, in the zero to plus or minus 180 degree convention.

The program has fairly complete entry checking and error trapping. Most errors will not stop program operation, but will display an error message and allow you to continue. An exception is reading bad data from tape when trying to restore the ship's previous status. Since the program has no current ship's status to return to, it cannot continue.

The program listing is fairly well supplied with remarks to assist in figuring out what is being done in each part of the program.

### Running the program

After you have loaded the program into your computer and entered RUN, it displays a title and asks if you want instructions. (Note that any required single-character user entry gives instant response without

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| DISPLAY DICTIONARY: | @ |
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depressing the enter key.) If you press Y, a concise 15-line set of instructions is displayed; if you press N, the program bypasses the instructions and lets you select one of eight solar system primaries, or lets you return to a situation you had previously saved on cassette tape. If you pressed neither Y or N in response to the "Instructions?" question, an error message is displayed, and you may try again. Throughout the program, any detectable entry error is caught and corrected, or a retry is allowed.

The eight possible primaries that were chosen have little or no atmosphere; a landing on Earth, for example, would involve aerodynamic calculations which are excessively complicated. Of the eight, Mars is the most difficult to land upon due to its relatively high gravity, while Europa is the easiest. Therefore, for a landing on Mars you are given five times as much fuel as for a landing on Europa. In all cases, there is a considerable excess of fuel allowed. Io, Europa, Ganymede and Callisto are the four largest moons of Jupiter, while Titan is the largest moon of Saturn.

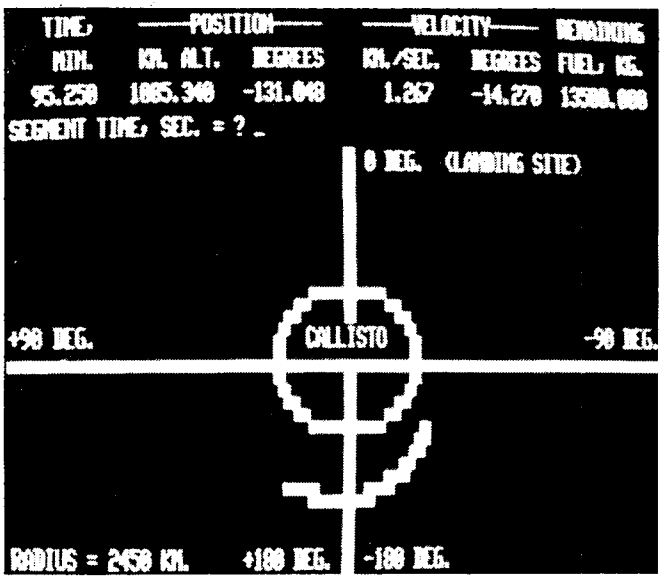
After you have chosen a primary, the program asks if you want a graphic or tabular display. The graphic display is in two stages. It first shows the progress of the ship in orbit, as shown in figure 1. Later, when the ship is near to landing, it shows a 10 km high by 20 km wide area near the landing site (see figure 2). Only the current status of the ship is shown at the top of the display. The tabular displays, in contrast, shows as many past segments of the ship's status as will fit on the video display (see figure 3). As the status segments scroll up, the heading remains in place. For orientation, the tabular display initially shows a graphical display of the position of the ship in orbit, but this is cleared before actual piloting begins.

Next, you may either enter a seed number of the BASIC RND function, or let the computer choose one. If you enter a seed number, entering the same seed number will always give the same initial status for the ship (if the same primary was chosen), so that a previous landing trial may be repeated. The computer will choose a different initial status each time.

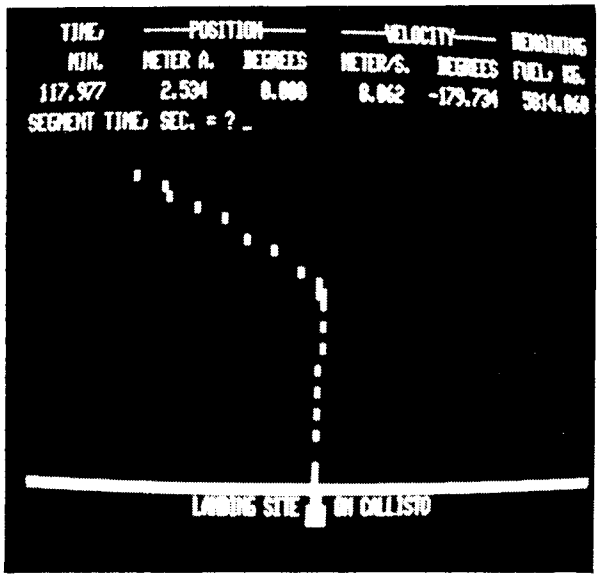
After the spaceship's position and orbit have been selected, piloting begins. You are first asked to enter the segment time. This is the simulated time that elapses between each evaluation and display of the ship's status. It may be any integer or decimal number of seconds up to 60 seconds. The default value (value used by the program if ENTER is pressed without a numerical entry) is 60 seconds. To gain access to the "On-board computer" (explained later), enter "99" as the segment time.

Next, the program asks for the number of segments, whose duration was specified above, to be calculated. This may be any integer number up to 32767. The default value for the number of segments is one. It is often convenient to enter a large number for the number of segments to be calculated, watch the progress of the ship on the display, then stop calculations when things have gone far enough by pressing any key.

The program next asks for the fuel burn-rate to be used. This may by any integer or decimal number of




A graphic display of a landing in progress on Callisto. The current status of the ship is shown at the top of the display, and the orbit path is shown graphically.




A graphic display of a landing almost completed on Callisto. The current status now shows meters altitude and meters/sec. velocity. The position of the ship at the end of each segment is shown graphically on a 10 km. high by 20 km. wide display.

kilograms per second (kg/second) up to 100 kg/second. The default value is a zero burn rate, or free-fall. Note that three quick presses of ENTER, without any numerical entries, gives one 60-second free-fall segment.

If the burn rate was not zero, the program next asks for the direction of thrust for the rocket burn, in degrees. The directions are the same as those shown on the graphics display. The default value is zero degrees, or straight up if the ship is in the final stages of landing at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```
TIME,      ----POSITION----      ----VELOCITY----   REMAINING
 MIN.     KM. ALT.   DEGREES    KM./SEC.   DEGREES  FUEL, KG.
 0.000   1769.490   -94.440     1.246    175.875  15000.000
SEGMENT TIME, SEC. = ? 60
NO. OF SEGMENTS = ? 4
BURN RATE, KG./SEC. = ? 0
 1.000   1769.910   -95.454     1.246    174.880  15000.000
 2.000   1770.360   -96.469     1.246    173.885  15000.000
 3.000   1770.840   -97.483     1.245    172.890  15000.000
 4.000   1771.340   -98.498     1.245    171.896  15000.000
SEGMENT TIME, SEC. = ? 10
NO. OF SEGMENTS = ? 1
BURN RATE, KG./SEC. = ? 100
THRUST DIRECTION, DEG. = ? -10
 4.167   1771.440   -98.656     1.082    171.991  14000.000
SEGMENT TIME, SEC. = ? _
```

The optional tabular display of a landing in progress. Several past user entries and the status for several past segments are shown. The heading remains in place at the top of the display, while the user entries and the status scroll up.

```
TIME,      ----POSITION----      ----VELOCITY----   REMAINING
 MIN.     METER A.   DEGREES    METER/S.   DEGREES  FUEL, KG.
118.015    0.000      0.000      0.067   -180.000  5772.430

CONGRATULATIONS - - - YOU ARE DOWN SAFELY ON CALLISTO!!!!
YOUR IMPACT VELOCITY WAS .04356 METERS/SECOND
YOUR DIRECTION OF IMPACT WAS -179.999 DEGREES
YOU MISSED THE LANDING SITE BY 3.0539 METERS
YOU HAVE 5772.33 KILOGRAMS OF FUEL LEFT
IT TOOK YOU 118.015 MINUTES TO GET DOWN

DO YOU WANT TO TRY ANOTHER LANDING (Y OR N)? _

                    LANDING SITE ON CALLISTO
```

The display after a successful landing on Callisto. The exact results for the moment of impact with the surface are interpolated.

the target landing site (at a position angle of zero degrees).

The program now calculates and displays the results of your piloting commands. If all goes well, you will be making progress towards a soft, vertical landing at the target landing site. If not, you may run out of fuel and crash. When the number of segments that you specified have been calculated, or if you press any key to stop calculations, you will be returned to the "Segment time" question. If you landed (or crashed) during the segments

Text continues on page 72


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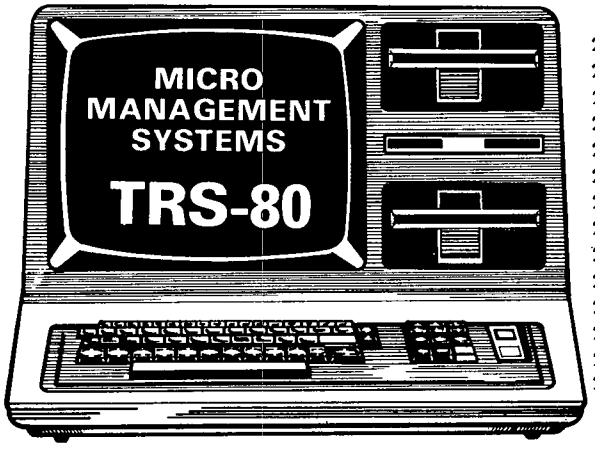


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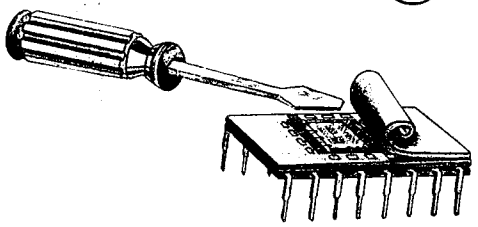
**Table 1**
**Variables used in "Spaceship Orbitor"**
A-H are single precision
I-N are integer
P-Y are double precision

**A** Multi-use variable
**AA** Position angle for orbit analysis
**AB** Velocity angle for orbit analysis
**AC** New position angle for orbit analysis
**AD** Delta angle between position and velocity
**AF** Final altitude, final position angle
**AG** User entry angle (degrees)
**AI** Initial altitude, initial position angle
**AL** Ship's altitude
**AM** Angular momentum
**AN** Random angle, ship's radius
**AO** Position angle of orbit minimum (degrees)
**AR** Radius from ship to center of primary
**AT** Ship's altitude for display
**AV** Random angle for delta velocity, new velocity
**AW** New velocity angle
**A0** Position angle of orbit minimum
**A1** Minimum orbit altitude
**BV** Ship's velocity
**CO** Velocity to circularize orbit
**CT** Cumulative time to impact
**CV** Velocity for display, circular orbit velocity
**DD** Desired direction, delta velocity direction (degrees)
**DI** Delta velocity to initiate Hohmann transfer
**DM** Distance of miss from landing site
**DP** Direction from primary (degrees)
**DR** Direction of rocket burn thrust
**DV** Delta velocity, desired velocity, velocity angle
**DX** Delta "X" velocity
**DY** Delta "Y" velocity
**E** Error code
**EC** Eccentricity of orbit
**EN** Energy of orbit
**F** Required fuel usage
**FR** Fuel remaining after impact
**FU** Fuel
**FV** Final velocity
**GC** Gravity constant of primary
**GV** Ground impact velocity
**H** Ship's mass
**HT** Hohmann transfer time
**H$** Name of primary
**I** Integer FOR loop counter
**IC** On-board computer flag, 1=yes
**IG** Graphics flag, 1=yes
**IR** Random seed for high byte
**IX** Ship graphics "X" position
**IY** Ship graphics "Y" position
**J** Integer FOR loop counter
**JG** Tabular graphics display flag, 1=yes


# Accessing the TRS-80* ROM...



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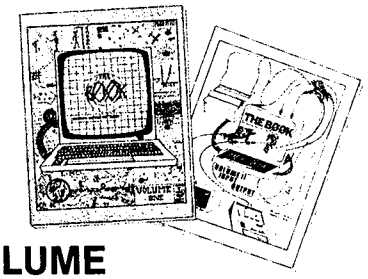


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Circle # 33

**JR** Random seed for middle byte
**K** Integer FOR loop counter
**KR** Random seed for low byte
**L** Lines of ship's status displayed
**LD** Near landing flag, 1=yes
**LG** Landing graphics background flag, 1=yes
**M** Ship's mass without fuel — 10,000 kg.
**N** User entry selection number
**NA** No good angle flag, 1=yes
**NG** Orbit graphics background flag, 1=yes
**NS** Number of segments
**O$** "Orbit" — to check recalled status file
**PI** Pi — 3.14159
**PX** New "X" position
**PY** New "Y" position
**Q** Radius correction factor; square of radius
**QA** Angle of gravity
**R** Ratio, ship's new radius
**RA** Ratio for impact status interpolation
**RB** Rate of burn of rocket engine
**RD** Radius from ship to center of primary
**RF** Final segment radius after impact
**RG** Radius for gravity
**RI** Initial segment radius after impact
**RS** User entry random seed
**R0** Radius of equivalent circular orbit
**S** Temporary radius
**SM** Ship's total mass
**SN** Ship's new total mass
**SR** Surface radius of primary, random seed temp #
**ST** Segment time
**S2** One-half of segment time
**TM** Elapsed time
**VG** Delta velocity due to gravity
**VL** Ship's velocity
**VX** New "X" velocity
**VY** New "Y" velocity
**XG** "X" velocity to estimate gravity
**XI** "X" impact velocity
**XP** "X" position
**XR** "X" velocity after rocket burn
**XV** "X" velocity
**YG** "Y" velocity to estimate gravity
**YI** "Y" impact velocity
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**YV** "Y" velocity
**Z$** User entry

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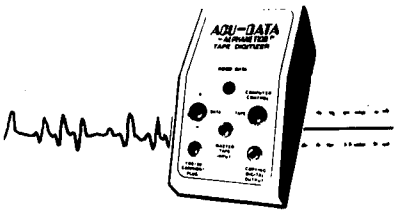


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being calculated, your impact status will be displayed as shown in figure 4. Note that when your altitude from the primary's surface becomes less than 10 km the altitude display changes from km to meters, and the velocity display changes from km/sec. to meters/sec. This makes it easier to give the fine control needed for a soft landing.

### The on-board computer

This feature allows you to calculate some of the celestial mechanics values that you need to do a good job piloting (or to save the spaceship's current status on cassette tape). During calculations, the ship's current status is shown at the top of the display for reference, and the "initial" entry values default to the ship's current status. The four possible calculations are:

1. Hohmann transfer
2. Orbit analysis
3. Delta velocity to change ship's velocity and direction.
4. Required fuel usage for a given delta velocity.

In addition, you may save the ship's current status on cassette tape, end calculations and return to piloting or exit from the program and return to BASIC.

The Hohmann transfer is a minimum-fuel usage maneuver to go from a circular orbit at one altitude to a different circular orbit at a higher or lower altitude. Such a transfer requires two separate rocket burns, on opposite sides of the orbit. If you are going from a higher to a lower orbit (as for preparing to land from orbit), the first rocket burn is made so as to slow the ship down to the initial transfer orbit velocity, and also leave it traveling in an exactly horizontal direction (the ship's position angle plus or minus 90 degrees). Then free-fall until the ship is exactly half-way around the orbit from the position of the first rocket burn (position angle change of 180 degrees). At this lowest point on the transfer orbit, make a second rocket burn exactly opposite to the ship's velocity direction to slow down to the circular orbit velocity at this new altitude. Actually, for making a landing this second rocket burn would normally be made approximately over the landing site, and would be continued long enough to stop all horizontal velocity.

To use the Hohmann transfer routine, key in the initial altitude (or just press ENTER to use the ship's current altitude), then key in the desired final altitude (default, zero altitude). Eight values will then be displayed. The circular orbit velocity at the initial altitude, the delta velocity (change in velocity) to initiate the Hohmann transfer, the initial Hohmann transfer orbit velocity, the time required to make the transfer, the final transfer orbit velocity, the delta velocity required to circularize the orbit at the new final altitude, the circular orbit velocity at the new altitude and the total delta velocity required for the maneuver. Delta velocities which are negative mean to slow down,


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while positive delta velocities mean to speed up.

The orbit analysis routine will determine the minimum altitude of the orbit and the minimum altitude position. It will also calculate the velocity and altitude at any other position angle on the orbit. This is very useful for helping to decide what to do.

To use the orbit analysis routine, either key in the four values that define the ship's position and velocity, or just press ENTER four times to use the ship's current status. The display will then show either "Elliptical orbit" or "Hyperbolic orbit" for the ship, and also the position angle and altitude of the orbit minimum. The routine will then ask for a new position angle. When you enter an angle (default is zero), the display will show the altitude and velocity of the orbit at this new position angle. For hyperbolic orbits, it may happen that no orbit exists at the entered position angle.

The delta velocity routine calculates the direction and magnitude of the velocity change required to adjust the ship's trajectory from one direction and speed to a different direction and speed. This is essentially a two-dimensional vector subtraction.

To use the delta velocity routine, key in the initial velocity angle and magnitude (or just press ENTER twice to use the ship's current velocity), then key in the desired final velocity angle and magnitude. The display will then show the velocity angle and magnitude required to change the ship's velocity from the initial status to the new status.

The fuel usage routine calculates how much fuel must be burned to give the ship the desired delta velocity. This usage depends upon the total mass of the ship and upon the rocket exhaust velocity (assumed to be 4km/sec. for the hydrogen/oxygen fuel that the spaceship uses).

To use the fuel usage routine, key in the ship's mass (or just press ENTER to use the ship's current mass), then key in the delta velocity. The display will show the fuel usage required to give that delta velocity.

The ship's current status may be saved on cassette tape either to continue the problem at a later time or to insure that the failure of a "dangerous" maneuver does not make it necessary for you to start over from the beginning. After the ship's status has been saved on tape, it may be recalled at any time by exiting from the program, then entering RUN to restart the program and selecting the "Recall previous status" option instead of a primary.

Remember when using the "On-board computer" that its calculations are single precision, and therefore will not agree exactly with the actual motion of the spaceship.

When you are through using the On-board computer routines, you may either return to piloting the spaceship or exit from the program and return to BASIC.

### Efficient piloting

Theoretically, the most efficient (lowest fuel usage) way to make a landing from orbit is to wait until the ship is at a position angle of 180 degrees (directly


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opposite the landing site at zero degrees), make a rocket burn to put the ship into a Hohmann transfer orbit to zero altitude at the target landing site, wait until the ship gets to the landing site, then stop. Of course, this isn't practical, as the ship cannot stop instantly, and a little room should be left for maneuvering. However, the closer such a trajectory can be approached, the less fuel will be required.

After orbital motion has been stopped, and the ship is dropping vertically to a landing, fuel usage is minimized by waiting as long as possible before making a rocket burn, then using maximum thrust to slow down for a soft landing.

Nearly all available memory of a 16K TRS-80 is used by this program. Only about 40 bytes are left unused (?MEM will still show over 100 bytes after an "out of memory" halt.) Therefore, if you want to add features to the program, be sure to delete enough of the remarks to give sufficient space. Model III users will have to delete a minimum of 258 bytes.

Good luck! (You will need it at first).

### Program listing

```
10 CLS : RANDOM
20 PRINT"<- CELESTIAL MECHANICS ORBITOR
   :  SPACESHIP LANDING ->"
30  ' (C) BY  D. D. HINRICHS  1979
40 DEFINT I-N : DEFDBL P-Y : M=1E4 : PI
   =3.1415926535897932
50 PRINT : PRINT"DO YOU WANT INSTRUCTIO
   NS (Y OR N)?"
60 GOSUB 3330 : IF Z$="Y" GOTO 3030 ELS
   E IF Z$="N" GOTO 80
70 GOSUB 3310 : GOTO 50
80 PRINT :PRINT"SELECT A PRIMARY THAT Y
   OU WISH TO ORBIT AND LAND UPON.", "YO
   UR FUEL SUPPLY IS ADJUSTED ACCORDINGL
   Y."
90 PRINT"  1.  MERCURY"
100 PRINT"  2.  THE MOON"
110 PRINT"  3.  MARS"
120 PRINT"  4.  IO"
130 PRINT"  5.  EUROPA"
140 PRINT"  6.  GANYMEDE"
150 PRINT"  7.  CALLISTO"
160 PRINT"  8.  TITAN"
170 PRINT"  9.  RECALL PREVIOUS STATUS
   FROM CASSETTE TAPE"
180 PRINT"WHICH DO YOU WANT TO TRY?";
190 GOSUB 3330 : CLS : N=VAL(Z$)
200 IF N=9 GOTO 2950
210 IF N<1 OR N>8 GOSUB 3310 : GOTO 80
```

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```
220 PRINT"DO YOU WANT GRAPHIC OR TABULA
  R DISPLAY (G OR T)?"
230 GOSUB 3330 : IF Z$="G" OR Z$="T" GO
  TO 250
240 GOSUB 3310 : GOTO 220
250 CLS : GOSUB 3220 : CLS : PRINT"SELE
  CTING ORBIT"
260 RESTORE : FOR J=1 TO N*4-3 : READ H
  $ : NEXT J
270 READ H$, GC, SR, SM
280 AN=RND(0)*2*PI-PI : RD=SR+100+RND(0
  )*2400
290 XP=RD*COS(AN) : YP=RD*SIN(AN)   '  S
  HIP'S X & Y POSITION
300 VL=SQR(GC/RD)                   '  S
  HIP'S VELOCITY
310 IF RND(0)>.5 THEN AN=AN+PI/2 ELSE A
  N=AN-PI/2
320 XV=VL*COS(AN) : YV=VL*SIN(AN)   '  S
  HIP'S X & Y VELOCITY
330 AV=RND(0)*2*PI-PI : R=SR/RD     '  A
  NGLE FOR RANDOM DELTA V
340 DV=VL*(SQR(2*R/(1+R))-1)        '  D
  ELTA VELOCITY TO SURFACE
350 XV=XV+RND(0)*DV*COS(AV) : YV=YV+RND
  (0)*DV*SIN(AV)
360 IF Z$="G" THEN IG=1 ELSE GOSUB 2610

370 ON ERROR GOTO 3360 : GOSUB 2330
380 IF IG=0 INPUT"PRESS 'ENTER'"; Z$ :
  CLS : L=0 : GOSUB 2330
390   '  REENTRY POINT, COMMAND FOR NEXT
   SET OF SEGMENTS
400 ST=60 : INPUT"SEGMENT TIME, SEC. =
  "; ST : GOSUB 2810
410 ST=ABS(ST) : IF ST=99 CLS : GOTO 12
  20   '  ON-BOARD COMPUTER
420 IF ST>60 PRINT"TIME REDUCED TO 60 S
  EC." :ST=60 :GOSUB 2780
430 S2=ST/2
440 NS=1 : INPUT"NO. OF SEGMENTS = "; N
  S : GOSUB 2810
450 NS=ABS(NS)
460 RB=0 : INPUT"BURN RATE, KG./SEC. =
  "; RB : GOSUB 2810
470 RB=ABS(RB) : IF RB=0 GOTO 510
    '  DEFAULT, FREE-FALL
480 IF RB>100 PRINT"BURN RATE REDUCED T
  O 100":RB=100:GOSUB 2780
490 AG=0 : INPUT"THRUST DIRECTION, DEG.
   = "; AG : GOSUB 2810
500 GOSUB 2190 : IF NA=0 THEN DR=AG ELS
  E 490
510 FOR K=1 TO NS
    '  CALCULATE EACH SEG.
520   IF RB=0 THEN XR=XV :YR=YV :SN=SM
  :GOTO 570   '  FREE-FALL
```

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Circle # 37

```
530   SN=SM-ST*RB
   '  SHIP'S NEW MASS
540   IF SN<=M PRINT"OUT OF FUEL" : SN=
  M : RB=0 : GOSUB 2780
550   DV=4*LOG(SM/SN)
   '  BURN DELTA VELOCITY
560   XR=XV+DV*COS(DR) : YR=YV+DV*SIN(D
  R)  '  X & Y VEL AFTER B
570   XG=(XR+XV)/2 : YG=(YR+YV)/2
   '  VEL. TO EST. GRAVITY
580   PX=XP+XG*S2 : PY=YP+YG*S2
   '  POS. TO EST. GRAVITY
590   RG=SQR(PX*PX+PY*PY)
   '  RADIUS FOR GRAVITY
600   Q=ST/RG/4 : RG=RG-GC*Q*Q
   '  RADIUS CORRECTION
610   QA=ATN(PY/PX)
   '  ANGLE FOR GRAVITY
620   IF PX<0 THEN QA=QA+PI : IF PY<0 T
  HEN QA=QA-2*PI
630   VG=GC/(RG*RG)*ST
   '  GRAVITY DELTA VEL.
640   VX=XR-VG*COS(QA) : VY=YR-VG*SIN(Q
  A)  '  FINAL VELOCITY
650   PX=XP+(XV+VX)*S2 : PY=YP+(YV+VY)*
  S2  '  FINAL POSITION
660   P=PX*PX+PY*PY : R=SQR(P)
       '  SHIP'S RADIUS
670   IF INKEY$<>"" GOTO 390
       '  EMERGENCY STOP?
680   IF R-SR<10 GOTO 710
       '  ALT. < 10 KM.?
690   IF LD=1 THEN LD=0 : L=0 : NG=0 :
  CLS : IF IG=0 THEN NG=1
700   GOTO 740
710   S=R :R=(P/S+S)/2 :IF S<>R GOTO 71
  0   '  ADJUST RADIUS
720   IF LD=0 THEN LD=1 : L=0 : LG=0 :
  CLS : IF IG=0 THEN LG=1
730   IF R-SR<=0 GOTO 780
       '  SURFACE IMPACT?
740   RD=R :XP=PX :YP=PY :XV=VX :YV=VY
  :SM=SN :TM=TM+ST/60
750   GOSUB 2330
       '  SHOW NEW STATUS
760   NEXT K
       '  NEXT SEGMENT
770 GOTO 390
       '  NEXT COMMAND
780   '  IMPACT ROUTINE
790 Q=XP*XP+YP*YP : RI=SQR(Q)
   '  INITIAL SHIP'S RADIUS
800 R=RI : RI=(Q/R+R)/2 : IF R<>RI GOTO
   800     '  ADJUST RADIUS
810 Q=PX*PX+PY*PY : RF=SQR(Q)
   '  FINAL SHIP'S RADIUS
820 R=RF : RF=(Q/R+R)/2 : IF R<>RF GOTO
   820     '  ADJUST RADIUS
830 RA=(SR-RF)/(RI-RF)
       '  RATIO, C/D
840 FV=SQR(VX*VX+VY*VY)
       '  FINAL VELOCITY
850 XI=VX+RA*(XV-VX) : YI=VY+RA*(YV-VY)
       '  X & Y IMPACT VEL.
860 GV=(FV+RA*(BV-FV))*1000 : PRINT
       '  IMPACT VELOCITY
870 IF GV>1 PRINT"********  YOU CRASHED
    ********"; : GOTO 890
880 PRINT"CONGRATULATIONS  -  -  -  YOU
   ARE DOWN SAFELY";
890 PRINT" ON "; H$ ; "!!!!"
900 PRINT"YOUR IMPACT VELOCITY WAS "; G
  V ; " METERS/SECOND"
910 DI=ATN(YI/XI)*180/PI
   '  DIRECTION OF IMPACT
920 IF XI<0 THEN DI=DI+180 : IF YI<0 TH
  EN DI=DI-360
930 PRINT"YOUR DIRECTION OF IMPACT WAS
  "; DI ; " DEGREES"
940 AF=ATN(PY/PX)
   '  FINAL POSITION ANGLE
950 IF PX<0 THEN AF=AF+PI : IF PY<0 THE
  N AF=AF-2*PI
960 AI=ATN(YP/XP)
   '  INITIAL POSIT. ANGLE
970 IF XP<0 THEN AI=AI+PI : IF YP<0 THE
  N AI=AI-2*PI
980 DM=SR*(AF+RA*(AI-AF))*1000
   '  MISS DISTANCE
990 PRINT"YOU MISSED THE LANDING SITE B
  Y "; DM ; " METERS"
1000 FR=SN+RA*(SM-SN)-M
   '  FUEL REMAINING
1010 PRINT"YOU HAVE "; FR ; " KILOGRAMS
   OF FUEL LEFT"
1020 CT=TM+(ST-RA*ST)/60
   '  CUM. TIME TO IMPACT
1030 PRINT"IT TOOK YOU "; CT ; " MINUTE
  S TO GET DOWN"
1040 PRINT
1050 IF IG=0 GOSUB 2280 : PRINT@ 960, ;

1060 PRINT"DO YOU WANT TO TRY ANOTHER L
  ANDING (Y OR N)?"
1070 GOSUB 3330 : IF Z$="Y" RUN
1080 PRINT : PRINT"UNTIL NEXT TIME, THE
  N"
1090 END
1100   '  CONSTANTS FOR VARIOUS PRIMARYS

1110 DATA 0, "MERCURY", 21522, 2440, 40
  000
1120 DATA "THE MOON", 4901, 1739, 25000
```

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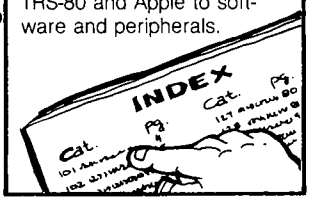


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```
1130 DATA "MARS", 43043, 3393, 60000
1140 DATA "IO", 5935, 1819, 25000
1150 DATA "EUROPA", 3235, 1563, 20000
1160 DATA "GANYMEDE", 9925, 2638, 30000

1170 DATA "CALLISTO", 7115, 2424, 25000

1180 DATA "TITAN", 9170, 2900, 30000
1190  '
1200  '  -  -  -  ALL SUBROUTINES AFTER
   THIS  -  -  -
1210  '
1220  '  THE "ON-BOARD COMPUTER" ROUTIN
  E, TO ASSIST PILOTING
1230 PRINT : PRINT"WHAT DO YOU WANT TO
  CALCULATE?   (FOR LANDING ON "; H$ ;
  ")", "'INITIAL' ENTRIES DEFAULT TO CU
  RRENT STATUS."
1240 PRINT : PRINT"  1.  HOHMANN TRANSF
  ER TO A NEW ALTITUDE"
1250 PRINT"  2.  ORBIT ANALYSIS"
1260 PRINT"  3.  DELTA VELOCITY TO CHAN
  GE STATUS"
1270 PRINT"  4.  FUEL USAGE FOR GIVEN D
  ELTA VELOCITY"
1280 PRINT"  5.  SAVE SHIP'S CURRENT ST
  ATUS ON CASSETTE TAPE"
1290 PRINT"  6.  END CALCULATIONS AND R
  ETURN TO PILOTING"
1300 PRINT"  7.  EXIT FROM PROGRAM"
1310 PRINT"ENTER NO. OF DESIRED ROUTINE
  ?" : GOSUB 3330
1320 CLS : L=0 : LG=0 : NG=0 : IC=1 : N
  =VAL(Z$)
1330 IF N<1 OR N>7 GOSUB 3310 : GOTO 12
  20
1340 IF N=6 THEN IC=0 : GOSUB 2330 : GO
  TO 390
1350 IF N=7 GOTO 1080
1360 GOSUB 2330 : ON N GOSUB 1390, 1580
  , 1910, 2090, 2890
1370 CLS : GOTO 1220
1380  '
1390 PRINT"*   *   *   HOHMANN TRANSFER
   CALCULATION  *   *   *"
1400 AI=AL : GOSUB 2220 : INPUT"ALTITUD
  E, KM."; AI
1410 IF AI<0 THEN Z$=STR$(AI) : GOSUB 3
  310 : GOTO 1400
1420 AF=0 : INPUT"ENTER FINAL ALTITUDE,
   KM."; AF
1430 IF AF<0 THEN Z$=STR$(AF) : GOSUB 3
  310 : GOTO 1420
1440 CV=SQR(GC/(AI+SR))
1450 PRINT"INITIAL CIRCULAR ORBIT VELOC
  ITY = "; CV; "KM./SEC."
1460 R=(AF+SR)/(AI+SR) : DI=CV*(SQR(2*R
  /(1+R))-1)
1470 PRINT"DELTA VEL. TO INITIATE TRANS
  FER = "; DI; "KM./SEC."
1480 PRINT"INITIAL TRANSFER ORBIT VELOC
  ITY = ";CV+DI;"KM./SEC."
1490 A=(AI+AF)/2+SR : HT=PI*SQR(A*A*A/G
  C)/60
1500 PRINT"HOHMANN TRANSFER TIME = "; H
  T ; "MINUTES"
1510 FV=SQR(GC/(AF+SR)) : CO=CV*(SQR(1/
  R)-SQR(2/(R*(1+R))))
1520 PRINT"FINAL TRANSFER ORBIT VELOCIT
  Y   = ";FV-CO;"KM./SEC."
1530 PRINT"DELTA VEL. TO CIRCULARIZE OR
  BIT = "; CO; "KM./SEC."
1540 PRINT"FINAL CIRCULAR ORBIT VELOCIT
  Y   = "; FV; "KM./SEC."
1550 PRINT"TOTAL DELTA V FOR ORBIT CHAN
  GE  = ";DI+CO;"KM./SEC."
1560 GOSUB 2240 :IF Z$="A" CLS:GOSUB 23
  30:GOTO 1390 ELSE RETURN
1570  '
1580 PRINT"*   *   *   ORBIT ANALYSIS
   *   *   *"
1590 AG=DP : GOSUB 2220 : INPUT"POSITIO
  N ANGLE, DEG. = "; AG
1600 GOSUB 2190 : IF NA=1 GOTO 1590 ELS
  E AA=AG
1610 GOSUB 2220 : INPUT"ALTITUDE, KM. =
   "; AL
1620 IF AL<0 THEN Z$=STR$(AL) : GOSUB 3
  310 : GOTO 1610
1630 AG=DV : GOSUB 2220 : INPUT"VELOCIT
  Y ANGLE, DEG. = "; AG
1640 GOSUB 2190 : IF NA=1 GOTO 1630 ELS
  E AB=AG
1650 GOSUB 2220 : INPUT"VELOCITY, KM./S
  EC. = "; BV : PRINT
1660 IF BV<0 THEN Z$=STR$(BV) : GOSUB 3
  310 : GOTO 1650
1670 AR=AL+SR : EN=BV*BV/2-GC/AR : AD=A
  B-AA : AM=BV*AR*SIN(AD)
1680 A=AM/GC : EC=SQR(1+2*EN*A*A) : R0=
  AM*A : A=(R0/AR-1)/EC
1690 IF EC>1 PRINT"HYPERBOLIC ORBIT"ELS
  EPRINT"ELLIPTICAL ORBIT"
1700 IF ABS(A)>=1 THEN A0=(1-SGN(A))*PI
  /2 : GOTO 1720
1710 A0=ATN(SQR(1-A*A)/A) : IF R0<AR TH
  EN A0=A0+PI
1720 A1=R0/(1+EC)-SR
1730 IF COS(AD)*SIN(AD)>0 THEN A0=AA-A0
   ELSE A0=AA+A0
1740 IF ABS(A0)>PI THEN A0=A0-2*PI*SGN(
  A0)
1750 AO=A0/PI*180
```

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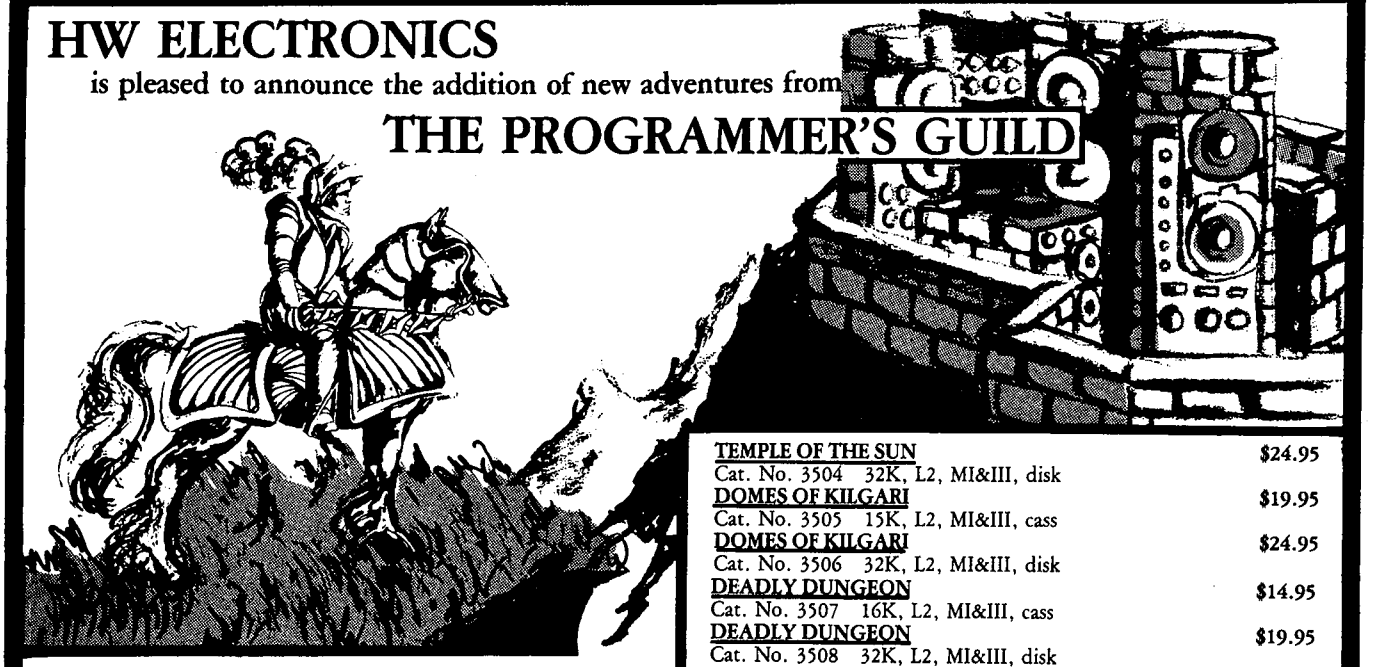

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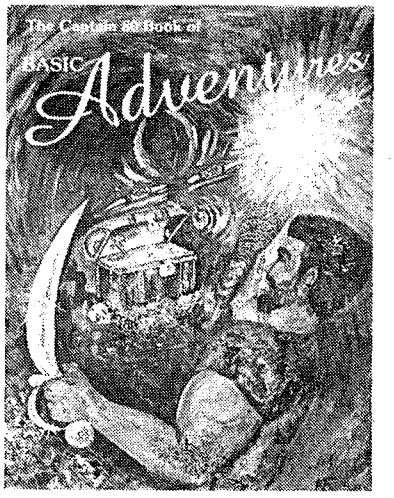


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```
1760 PRINT"POSITION ANGLE OF ORBIT MINI
  MUM = "; AO ;" DEG."
1770 PRINT"MINIMUM ORBIT ALTITUDE = ";
  A1 ; " KM." : PRINT
1780 AG=0 : INPUT"ENTER NEW POSITION AN
  GLE, DEG. = "; AG
1790 GOSUB 2190 : IF NA=1 GOTO 1780 ELS
  E AC=AG
1800 AN=(R0/(1+EC*COS(AC-A0))) : AV=SQR
  (2*(EN+GC/AN))
1810 IF AN<0 PRINT"NO ORBIT AT THIS ANG
  LE" : GOTO 1890
1820 PRINT"NEW ALTITUDE = "; CSNG(AN-SR
  ) ; " KM."
1830 A=AM/AV/AN : IF ABS(A)>=1 THEN AW=
  PI/2*SGN(A) : GOTO 1850
1840 AW=ATN(A/SQR(1-A*A))
1850 IF AM*SIN(AC-A0)<0 THEN AW=AC-AW+P
  I ELSE AW=AC+AW
1860 IF ABS(AW)>PI THEN AW=AW-SGN(AW)*2
  *PI
1870 PRINT"NEW VELOCITY ANGLE = "; CSNG
  (AW/PI*180) ; " DEG."
1880 PRINT"NEW VELOCITY = "; AV ; " KM.
  /SEC."
1890 GOSUB 2240 : IF Z$="A" GOTO 1780 E
  LSE RETURN
1900  '
1910 PRINT"*    *    DELTA VELOCITY TO CH
  ANGE STATUS    *    *"
1920 PRINT
1930 AG=DV : GOSUB 2220 : INPUT"DIRECTI
  ON, DEGREES"; AG
1940 GOSUB 2190 : IF NA=1 GOTO 1930 ELS
  E AD=AG
1950 AV=BV : GOSUB 2220 : INPUT"VELOCIT
  Y, KM./SEC."; AV
1960 IF AV<0 THEN Z$=STR$(AV) : GOSUB 3
  310 : GOTO 1950
1970 AG=0 : INPUT"ENTER DESIRED DIRECTI
  ON, DEGREES"; AG
1980 GOSUB 2190 : IF NA=1 GOTO 1970 ELS
  E DD=AG
1990 DV=0 : INPUT"ENTER DESIRED VELOCIT
  Y, KM./SEC."; DV
2000 IF DV<0 THEN Z$=STR$(DV) : GOSUB 3
  310 : GOTO 1990
2010 DX=DV*COS(DD)-AV*COS(AD) : DY=DV*S
  IN(DD)-AV*SIN(AD)
2020 DV=SQR(DX*DX+DY*DY) : IF DX=0 THEN
   DX=1E-10
2030 DD=ATN(DY/DX)*180/PI
2040 IF DX<0 THEN DD=DD+180 : IF DY<0 T
  HEN DD=DD-360
2050 PRINT :PRINT"DIRECTION OF DELTA VE
  LOCITY = ";DD;" DEGREES"
2060 PRINT"REQUIRED DELTA VELOCITY = ";
   DV ; " KM./SEC."
2070 GOSUB 2240 :IF Z$="A" CLS:GOSUB 23
  30:GOTO 1910 ELSE RETURN
2080  '
2090 PRINT"*  FUEL USAGE REQUIRED FOR A
   GIVEN DELTA VELOCITY *"
2100 PRINT"  (ASSUMING A 4 KM./SEC. ROC
  KET EXHAUST VELOCITY)"
2110 PRINT
2120 H=SM : GOSUB 2220 : INPUT"SHIP'S M
  ASS, KG."; H
2130 IF H<0 THEN Z$=STR$(H) : GOSUB 331
  0 : GOTO 2120
2140 DV=0 : INPUT"ENTER DESIRED DELTA V
  ELOCITY, KM./SEC."; DV
2150 IF DV<0 THEN Z$=STR$(DV) : GOSUB 3
  310 : GOTO 2140
2160 F=H-H/EXP(DV/4)
2170 PRINT : PRINT"REQUIRED FUEL USAGE
  = "; F ; " KILOGRAMS"
2180 GOSUB 2240 :IF Z$="A" CLS:GOSUB 23
  30:GOTO 2090 ELSE RETURN
2190  '  CHECK ENTRY ANGLE
2200 NA=0 : IF ABS(AG)<=180 THEN AG=AG*
  PI/180 : RETURN
2210 Z$=STR$(AG) : GOSUB 3310 : NA=1 :
  GOSUB 2780 : RETURN
2220  '  ENTRY ROUTINE
2230 PRINT"ENTER INITIAL "; : RETURN
2240  '  ANSWER ROUTINE
2250 PRINT
2260 PRINT"ENTER 'A' FOR ANOTHER, ELSE
  RETURN TO MENU";
2270 GOSUB 3330 : PRINT : RETURN
2280  '  STATUS DISPLAY HEADING
2290 PRINT@ 0,"   TIME,    -----POSITIO
  N-----    -----VELOCITY-----  REMAINI
  NG"
2300 PRINT"    MIN.    KM. ALT.   DEGRE
  ES    KM./SEC.   DEGREES  FUEL, KG.";

2310 IF LD=1 PRINT@ 76, "METER A"; : PR
  INT@ 98, "METER/S";
2320 RETURN
2330  '  CALCULATE STATUS DISPLAY
2340 AL=RD-SR : AT=AL              '  ALT
  ITUDE FROM SURFACE
2350 DP=ATN(YP/XP)*180/PI          '  DIR
  ECTION FROM PRIMARY, DEG
2360 IF XP<0 THEN DP=DP+180 : IF YP<0 T
  HEN DP=DP-360
2370 BV=SQR(XV*XV+YV*YV) :CV=BV  '  SHI
  P'S NEW VELOCITY
2380 DV=ATN(YV/XV)*180/PI          '  SHI
  P'S VEL. DIRECTION, DEG
2390 IF XV<0 THEN DV=DV+180 : IF YV<0 T
  HEN DV=DV-360
```

```
2400 FU=SM-M                          ' SHI
  P'S REMAINING FUEL
2410 IF L<>0 OR IG=0 OR IC=1 GOTO 2440
      ' NO GRAPHICS?
2420 IF LD=0 AND NG=0 GOSUB 2610
      ' ORBIT GRAPHICS?
2430 IF LD=1 AND LG=0 GOSUB 2730
      ' LANDING GRAPHICS?
2440 IF LD=1 THEN AT=AT*1000 : CV=CV*10
  00  ' CONVERT TO METERS
2450 IF L=0 GOSUB 2280 : PRINT
      ' PRINT HEADING?
2460  ' PRINT CURRENT STATUS
2470 IF IG=1 PRINT@ 128, ;
2480 PRINT USING"####.###"; CSNG(TM) ;
2490 PRINT USING"#######.###"; AT, DP,
  CV, DV, FU
2500 IF IC=1 RETURN
2510 IF IG=0 AND JG=1 GOSUB 2810 : RETU
  RN  ' NO GRAPHICS?
2520 IF LD=1 THEN L=1 : GOTO 2570
      ' NEAR LANDING?
2530  ' ORBITING GRAPHICS, SHIP
2540 JG=1 : IX=64-YP/SR*14 : IF IX<0 OR
   IX>127 RETURN
2550 IY=30-XP/SR*6 : IF IY<9 OR IY>47 R
  ETURN
2560 SET(IX,IY) : SET(IX+1,IY) : RETURN

2570  ' LANDING GRAPHICS, SHIP
2580 IX=64-YP*6.4 : IF IX<0 OR IX>127 R
  ETURN
2590 IY=44-(XP-SR)*3.2 : IF IY<9 OR IY>
  44 RETURN
2600 SET(IX,IY) : RETURN
2610  ' ORBIT GRAPHICS, BACKGROUND
2620 CLS
2630 PRINT@ 538,CHR$(176); CHR$(156); C
  HR$(134); STRING$(7,131);      CHR$(14
  0); CHR$(180); CHR$(144)
2640 PRINT@ 601, CHR$(190); CHR$(129);
  CHR$(203); CHR$(171);          CHR$(14
  8)
2650 PRINT@ 640, STRING$(25,131); CHR$(
  175); CHR$(147);               STRING$
  (11,131); CHR$(187); CHR$(135); STRIN
  G$(24,131)
2660 PRINT@ 730,CHR$(131); CHR$(141); C
  HR$(164); STRING$(7,176);      CHR$(14
  0); CHR$(135); CHR$(129)
2670 FOR I=0 TO 9 : PRINT@ 352+I*64, CH
  R$(191); : NEXT I
2680 PRINT@ 982, "+180 DEG. "; CHR$(191
  ); " -180 DEG.";
2690 PRINT@ 576, "+90 DEG."; : PRINT@ 6
  32, "-90 DEG.";
2700 PRINT@ 604, H$ ; : GOSUB 2870
```


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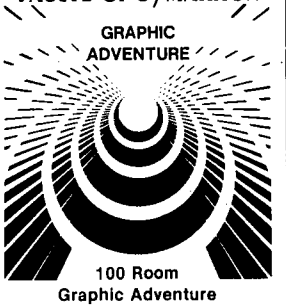

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```
2710 PRINT@ 960, "RADIUS ="; SR ; "KM."
  ;
2720 NG=1 : RETURN
2730  '  LANDING GRAPHICS, BACKGROUND
2740 CLS
2750 PRINT@ 896, STRING$(32,176); STRIN
  G$(32,176);
2760 PRINT@978,"LANDING SITE "; CHR$(19
  0); CHR$(189);" ON ";H$;
2770 LG=1 : RETURN
2780  '  DELAY LOOP
2790 IF IC=1 RETURN
2800 FOR J=1 TO 1000 : NEXT J
2810  '  LINE CHECK ROUTINE
2820 L=L+1 : IF L>13 AND IG=0 GOSUB 228
  0 : PRINT@ 960, ;
2830 IF IG=0 RETURN
2840  '  CLEAR INPUT LINE AND REPLACE L
  EGEND
2850 PRINT@ 192, CHR$(30)
2860 IF LD=1 GOTO 2880
2870 PRINT@ 288, CHR$(191); " 0 DEG.  (
  LANDING SITE)";
2880 PRINT@ 192, ; : RETURN
2890  '  SAVE CURRENT STATUS ON TAPE
2900 CLS : O$="ORBIT"
2910 INPUT"POSITION TAPE, PRESS 'RECORD
  ' THEN 'ENTER'"; Z$
2920 CLS : PRINT"SAVING SHIP'S CURRENT
  STATUS"
2930 PRINT#-1, O$,H$,GC,RD,SR,SM,TM,XP,
  YP,XV,YV,BV,IG,LD
2940 RETURN
2950  '  GET PREVIOUS STATUS FROM TAPE
2960 O$=""
2970 INPUT"POSITION TAPE, PRESS 'PLAY'
  THEN 'ENTER'"; Z$
2980 CLS : PRINT"RESTORING SHIP'S PREVI
  OUS STATUS"
2990 INPUT#-1, O$,H$,GC,RD,SR,SM,TM,XP,
  YP,XV,YV,BV,IG,LD
3000 IF O$="ORBIT"THEN L=0:LG=0:JG=1:NG
  =0 :GOSUB 2330 :GOTO 390
3010 PRINT : PRINT"******  WRONG FILE
  ******"
3020 PRINT"TRY AGAIN" : PRINT : GOTO 29
  70
3030  '  INSTRUCTIONS
3040 CLS
3050 PRINT"YOU ARE THE PILOT OF A SPACE
  SHIP IN A RANDOM ELLIPTICAL ORBIT"
3060 PRINT"AROUND ONE OF EIGHT NEARLY A
  IRLESS PRIMARIES.  YOU MUST CONTROL"
3070 PRINT"THE TIMING, DURATION, INTENS
  ITY, AND DIRECTION OF THE ROCKET"
3080 PRINT"BURNS SO AS TO LAND GENTLY (
   < 1 METER/SEC.) AT THE TARGET SITE"
3090 PRINT"(AT 0 DEG.) WITHOUT RUNNING
  OUT OF FUEL.  YOU MAY RUN ANY"
3100 PRINT"NUMBER OF FREE-FALL OR ROCKE
  T BURN SEGMENTS AUTOMATICALLY."
3110 PRINT"OPERATION OF THE SPACESHIP I
  S AS FOLLOWS:"
3120 PRINT"  1.  CHOOSE PRIMARY FOR LAN
  DING.  (A RANDOM ORBIT IS SELECTED)"
3130 PRINT"  2.  ENTER SECONDS FOR EACH
   SEGMENT.  (MAXIMUM & DEFAULT = 60)"
3140 PRINT"       (ENTER '99' FOR HELP F
  ROM THE 'ON-BOARD COMPUTER')"
3150 PRINT"  3.  ENTER NUMBER OF SEGMEN
  TS.  (DEFAULT = 1)"
3160 PRINT"  4.  ENTER BURN RATE, KG./S
  EC.  (MAXIMUM = 100,   DEFAULT = 0)"
3170 PRINT"  5.  IF BURN WAS MADE, ENTE
  R THRUST DIRECTION.  (TO + OR -180)"
3180 PRINT"  6.  EVALUATE DISPLAY, THEN
   RETURN TO STEP 2."
3190 PRINT"  7.  AFTER SURFACE IMPACT,
  LANDING STATUS IS INTERPOLATED."
3200 INPUT"TO CONTINUE, PRESS 'ENTER'";
   Z$
3210 CLS : GOTO 80
3220  '  RANDOM SEED ENTRY
3230 PRINT "IF YOU WANT A REPRODUCABLE
  INITIAL STATUS, ENTER ANY INTEGER"
3240 PRINT"(UP TO 16777215)."
3250 PRINT"FOR A RANDOM INITIAL STATUS,
   JUST PRESS 'ENTER'";
3260 RS=0 : INPUT RS : CLS : IF RS=0 RE
  TURN
3270 IF RS>0 AND RS<16777216 AND INT(RS
  )=RS GOTO 3290
3280 Z$=STR$(RS) : GOSUB 3310 : GOTO 32
  20
3290 SR=INT(RS/256) : IR=RS-256*SR : KR
  =SR/256 : JR=SR-256*KR
3300 POKE 16556,IR : POKE 16555,JR : PO
  KE 16554,KR : RETURN
3310  '  BAD ENTRY
3320 PRINT"YOUR ENTRY '";Z$;"' IS ILLEG
  AL.  TRY AGAIN" :RETURN
3330  '  ENTRY
3340 Z$=""
3350 Z$=INKEY$ : IF Z$="" GOTO 3350 ELS
  E RETURN
3360  '  ERROR TRAP
3370 E=ERR/2+1 : PRINT : IF E=6 PRINT"O
  VERFLOW"; : GOTO 3400
3380 IF E=11 PRINT"/ BY 0"; : GOTO 3400

3390 PRINT"CODE "; E ;
3400 PRINT" ERROR IN LINE # "; ERL
3410 FOR I=1 TO 1000 : NEXT I : Z$="6"
  : RESUME 1320                    ■
```

# The Color Computer grows up

## *Adding a disk system*

Color Computer

Don Scarberry, Editor

There have been many new peripherals made available for the Color Computer which turn this little wonder into much more than the simple game machine it was thought to be. Radio Shack has confirmed their original claim of added support by introducing disk drive capability and a complete DOS (Disk Operating System) contained in a small ROM (Read Only Memory) cartridge. The ROM cartridge plugs directly into the computer's expansion port. If you own a Color Computer and have been wondering what advantages a disk system will provide compared to a cassette recorder, then read on.

The first and most obvious advantage of owning a disk drive is speed. Loading and saving program (or data files) using a cassette recorder is at best cumbersome. Your file must be stored on the cassette in sequential order along the entire length of the tape. If you need to load a file which is physically located near the end of the tape, you must wait for the recorder to travel past all other files before it can be loaded. If your file is sitting near the end of a C-60 cassette you will wait nearly 25 minutes before it can begin loading. Shorter cassettes will help improve loading time but at the expense of storage space. If you use C-10 cassettes your maximum access time will be approximately 0.1 to 5 minutes depending on the length and location of the file. That is still a long time when you are sitting idly waiting for something to happen. By comparison, a disk drive will allow much faster access to any file on a diskette without loss of storage capacity. File access time is measured in seconds rather than minutes.

Storage space on a single diskette will vary according to your computer and disk drive capabilities. You may already have heard the expressions "single density", "double density", "35-track", "40-track", and "80-track". These terms are indicative of the amount of storage space provided on a given diskette by your particular equipment. Radio Shack has provided the new disk drives for the Color Computer to be 35-track, double density. A track can be thought of as analogous to a groove in a stereo record. Each track contains 18 sectors consisting of 256 bytes each, or 18 x 256 = 4,608 bytes per track. One track is used by the disk drive for the directory (list of your files). This leaves 34 x 18 x 256 = 156,672 bytes of storage on one diskette for your files. So what's a byte? Think of it as one letter of the alphabet. You can store approximately 156,672 characters on one 35-track double-density diskette depending on your methods of storing files.

In addition to increased storage space and speed which the disk will bring to your Color Computer, the TRSDOS operating system will provide many new commands. These commands offer much more power and flexibility than is found on the cassette-based system. The following table lists all the new commands available with the disk system. It must be noted that these are additional commands. You may continue to use any of the usual extended BASIC color commands.

**Table 1**

BACKUP the contents of the source drive to the destination drive.

CLOSE closes communication to the buffers specified.

COPY copies the contents of filename 1 to filename 2.

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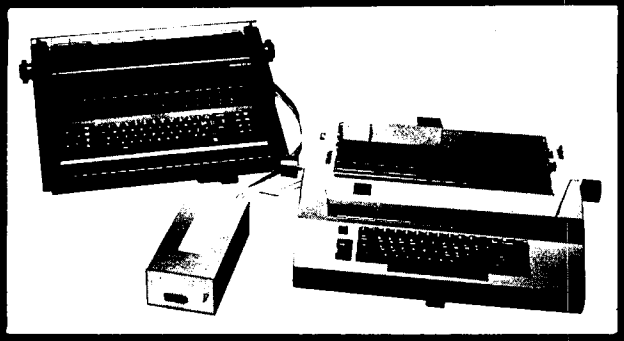

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## Hardware evaluation

CVN converts a 5-byte coded string (created by MKN$) back to the number it represents.

DIR displays a directory of the disk in the drive number you specify.

DRIVE changes the drive default to the drive number you specify.

DSKINI formats a disk in the drive number you specify.

DSKI$ inputs data from a certain sector within a certain track on the disk.

DSKO$ outputs string date into the sector, track and drive number you specify.

EOF returns a 0 if there is more data to be read in the buffer and a —1 if there is no more data in it.

FIELD organizes the space within a direct access buffer into fields.

FILES tells the computer how many buffers to reserve in memory and the total bytes to reserve for these buffers.

FREE returns the number of free granules on the disk in the drive number you specify.

GET gets the next record or the record number you specify, and puts in the buffer.

INPUT inputs data from the buffer you specify and assigns each data item in the buffer to the variable name you specify.

KILL deletes the filename you specify from the disk directory.

LINE INPUT inputs a line (all the data up to the ENTER character) from the buffer you specify.

LOAD loads the BASIC program file you specify from a disk into memory.

LOADM loads a machine-language program file from disk.

LOC returns the current record number of the buffer you specify.

LOF returns the highest numbered record of the buffer you specify.

LSET left justifies the data within the field name you specify.

MERGE loads a program file from disk and merges it with the existing program in memory.

MKN$ converts a number to a 5-byte coded string, for storage in a formatted disk file.

OPEN opens a place in memory called a buffer which will communicate data to and from a certain device.

PRINT prints the data to the buffer.

PRINT # buffer, USING format; data list. Prints data to the buffer using the format you specify.

PUT assigns a record number to the data in the buffer.

RENAME renames a file on disk to a new filename.

RSET right justifies the data within the field name you specify.

RUN loads filename from disk and runs it.

SAVEM saves a machine language program beginning at first address in memory and ending at last address.

UNLOAD closes any open files in the drive number you specify.

VERIFY ON

VERIFY OFF turns the verify function on and off.

WRITE writes the data to the buffer you specify.

If you are only accustomed to using the cassette-based model and upgrade to the new disk system, you will feel like you have a tiger by the tail!

Another nice feature of the TRSDOS operating system is that it is transparent to the operator. You are actually operating in TRSDOS and BASIC simultaneously. You won't have to continually issue new commands to switch back and forth from BASIC to TRSDOS and vice-versa. Model I or III owners will appreciate this feature. For example, if you wish to load a program from cassette and store it on disk you simply type "CLOAD(filename)" ENTER and then when the program is loaded, type "SAVE (filename)" ENTER. You can switch files back and forth between cassette and disk with absolutely no effort at all. Your programs may also control input/output between these two devices. Combine all this flexibility with the graphics capabilities of the Color Computer and you will have a very powerful system. In fact, a two-disk system provides more storage area than four disks did in the earlier Model I — and you can expand your Color Computer to a total of four drives!

The TRSDOS for the Color Computer resides in a ROM cartridge which plugs into the expansion port. This causes the operating system to grab approximately 2500 bytes of your memory away from the computer. If you have only a 16K machine (13095 bytes of actual available memory), you will have slightly over 11K of memory available for program use when using the disk system. Software which formerly required more than 11K to operate will not run with the disk system. Upgrading to 32K is strongly advised when using disks. You may not feel the need for this much RAM initially, but as you gain programming experience and your programs become longer, the need for more memory will definitely arise.

Another disadvantage to the color disk system at present is the fact that you will not be able to use disks and ROM cartridges at the same time. In order to use a ROM PAK you will have to disable the disk system. This may not be much of a problem for long though, because the port is for expansion and all that is needed is for some enterprising company to develop an expansion board that will allow multiple device connections.

Our unit has operated flawlessly since we received it and we are quite pleased with it. The manual is very easy to follow and explains everything from setup to actual use in very elementary terms. Do be careful when hooking the ribbon cable connecting the DOS ROM PAK and the actual disk drive. It is easy to get the connector mounted upside-down because the illustration describing this connection is not quite clear.

The price of one disk drive, cable and DOS ROMPAK cartridge is $599. The second, third and fourth drives sell for $399. each. The overall cost for a two-drive system is about the same as for a two-drive Model I system.

The Color Computer disk system is one of the best values available for high-speed, mass-storage devices. If you decide to upgrade to disk, most assuredly you will never want to go back to a cassette-based system. ■

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# Editor/Assembler 1.2 for three

## *EDTASM improved for Model I and revised for Model III*

### Model III

Kent G. Rothrock, Naperville, IL

The Model I Editor Assembler (26-2002) can be revised to operate on the Model III and improved for the Model I.

When I loaded and ran the Editor Assembler the first time on my Model III, I really wasn't expecting the sign on message I received. The screen displayed a message that only Charlie Chan could have deciphered. The new Tandy Triple obviously spoke in another tongue.

Before I sold my Model I, I had heard the rumors that many of Tandy's programs would not run on the Model III. Here was the proof. I pretended that I understood the note at the top of the screen and issued an EDTASM command. In a moment, a message appeared with which I was familiar. "Cass?"

I had just finished repairing T-BUG for the Model III and knew the cassette routines within EDTASM would also have to be revised. I had failed to realize that in this case, the keyboard and video driver routines would have to be changed as well.

The alterations that I made in the Editor Assembler allow it to operate on the Model III. Source tapes can be written or read at both baud rates. Thus, alterations in programs written originally for the Model I can be made. Object tapes may also be written at either speed.

The first 500 bytes of the original program are eliminated by calling on ROM routines. This allows the program stack to be relocated out of the Model III's buffer. Owners of both models will be able to use lower case text, assuming the necessary hardware modifications have been made to the Model I. Memory size set on power up is honored. This change was important to me because I have a selectric driver residing at the top of RAM. You may wish to preserve a lower case driver or KBFIX on the Model I.

Other than having the Editor Assembler itself, you must also have a utility program such as Three Bug that can be relocated above 5CFF hex.

The first step then is to load the monitor routine, move it to 5CFFH or higher, and run it. On the Model III, set memory location 4211H to 00H to select the low cassette speed and using the monitors Load command, Load EDTASM.

The following changes are made in the original Editor Assembler program. When more than one value follows an address, the values are entered in subsequent addresses. The Editor Assembler keyboard, video and printer drivers are replaced by ROM routines in this step. Enter:

```
M 4606 15 40

M 460B 1D 40

M 4610 25 40

M 4615 74 06
```

That last change at 4615H loads the address of the Model III General I/O driver. For the Model I, the values entered should be C2 03.

The original Editor Assembler masks out lower case letters. You may remove this block simply by entering:

```
M 4649 00 00 00 00
```

An unnecessary RAM check is performed between 4693H and 46A1H, overwriting high memory. To preserve the memory size set on power up, insert this new code.

```
M 4693 2A B1 40

M 4696 22 13 41
```

This next step is for the Model III. The inverse video question mark replaces the cursor symbol. Model I users must enter zeros here.

```
M 4699 21 23 40

M 469C 36 FC

M 469E 23 36 01 00
```

To relocate the stack to the area vacated by the Editor Assembler drivers, load 44H into these three locations: 46B2, 46DC, 529C.

Another change for the Model III owner sets the maximum characters to be printed per line and initializes the count to zero. A different value may be entered at 46BE. The 44H shown will result in a maximum length of 70 characters per line. Once again, you Model I types must enter zeros or use this area for your own initialization code.

```
M 46BA 21 2B 40

M 46BD 36 44

M 46BF 32 2A 40
```

The next set of changes replaces the cassette routines within the Editor Assembler with calls to the Model III ROM. Model I owners can use this as a guide in locating and replacing similar calls in their

machine. The major differences are that the ROM routines in the Model III that read and write the leader and sync byte, also turn on the recorder motor. The blinking asterisks, appearing as a program is loaded, are a part of the CSIN routine in the Model III and therefore no special call is made for this function in this revision.

The routines that are being replaced are located between 4318H and 43CDH. The changes printed in Table 1 are for the Model III computer only. The call to 0243H reads the header and sync byte. Calling 0287H writes the same items. Calls to 0235H and 024DH read and write a byte of data while 30C0H turns off the cassette motor. The change made at address 4DA6H through 4DA8 was originally a call to blink the asterisk.

The revised Editor Assembler will be saved and loaded at the high baud rate. Therefore, EDTASM will be initialized to produce high speed source code tapes. The code in Table 1 starting with address 4728 allows the Model III owner to change the cassette baud rate while in EDTASM command mode. Press the C key and answer the Cass? prompt with H or L. Before assembling and writing the object code to tape, select the low baud rate.

A final change that can be made is reserved for those with lower case capabilities. That initial sign on message really surprised me and I felt a need for revenge. The area within the Editor Assembler containing its messages starts at 476AH. If your monitor has a Dump command, you can see this text. The last character in each message has the most significant bit in its normal ASCII code set. For example, an R has the ASCII hex value of 52. This becomes F2 when the most significant bit is set. If you decide to alter any of the text in this area, you must follow the same procedure. I changed three messages. The sign on now says, "Model III Assembler Ver. 3.2". The following prompts appear at appropriate times: "CTR-80A Ready?" and "Ready Printer". The addresses and contents to allow these alterations are presented in Table 2.

Once you have completed making these changes, you can punch out a new copy. Model III users enter M 4211 01 to select the high baud rate, prepare the recorder and command:

```
P 45E6 5CFF 468A EDTASM
```

The corresponding entry for the Model I without the cassette revisions is:

```
P 4318 5CEF 468A EDTASM
```

**Table 1**

**Cassette Routine Changes**

| | | | |
|---|---|---|---|
| 45E6 | FE | 43 | |
| 45E8 | 20 | 06 | |
| 45EA | CD | 42 | 30 |
| 45ED | C3 | DA | 46 |
| 45F0 | 21 | A2 | 47 |
| 45F3 | C3 | 2B | 47 |
| 46DE | 0C | 30 | |
| 4728 | C3 | E6 | 45 |
| 4743 | 4D | 02 | |
| 4D46 | 4D | 02 | |
| 4D58 | 43 | 02 | |
| 4D5B | 35 | 02 | |
| 4D70 | 35 | 02 | |
| 4D79 | 35 | 02 | |
| 4D96 | 35 | 02 | |
| 4DA6 | 00 | 00 | 00 |
| 4DB4 | 35 | 02 | |
| 4DBB | 35 | 02 | |
| 4F35 | 87 | 02 | |
| 4F3A | 4D | 02 | |
| 4F40 | 4D | 02 | |
| 4F49 | 4D | 02 | |
| 59AF | 4D | 02 | |
| 59B3 | 4D | 02 | |
| 59B6 | 4D | 02 | |
| 5CCD | 4D | 02 | |
| 5CD3 | 4D | 02 | |

**Table 2**

**Message Revisions**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 48C9 | 4D | 6F | 64 | 65 | 6C | 20 | 49 | 49 |
| 48D1 | 49 | 20 | 41 | 73 | 73 | 65 | 6D | 62 |
| 48D9 | 6C | 65 | 72 | 20 | 56 | 65 | 72 | 20 |
| 48E1 | 33 | 2E | B2 | 43 | 54 | 52 | 2D | 38 |
| 48E9 | 30 | 41 | 20 | 52 | 65 | 61 | 64 | 79 |
| 48F1 | BF | 52 | 65 | 61 | 64 | 79 | 20 | 50 |
| 48F9 | 72 | 69 | 6E | 74 | 65 | F2 | | |

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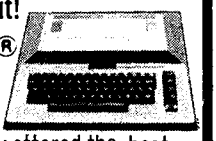

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# Captain 80

© 1982, Bob Liddil

Here's the Software Secret Agent, trenchcoat aback, mirror shades reflecting the California sunshine beneath the brim of a battered Sam Spade hat. Investigative reporting is the name of the game and uncovering information is the wave to my surfboard.

I am a movie buff, a cinemaphile, if you will. I saw Time Bandits in England where it was filmed and watched Midnight Man (an old Burt Lancaster movie) *being* filmed. I have seen computers represented in the cinema in every form conceivable, from the wimpish and slightly psychotic HAL in "2001, A Space Odyssey", to the overzealous, intent on becoming human, cyber-entity in "Demon Seed". But, never have I seen anything to compare to a new film called "Evilspeak".

Picture this: A chubby, socially unacceptable youth is enrolled in a military academy where he is mercilessly hazed by resident neanderthals. He introverts and discovers the school computer (simultaneous to discovering a cellar full of Latin-based black mass bibles).

Enterprising lad that he is, he cranks up a Latin translating database on his newly acquired 48K single disk drive Apple II, renders to English the contents of one of the volumes, and types in a new program to *summon the Devil*!!! And he *does it*!! You can bet that the manufacturers of our humble TRS-80s don't have a program that'll do that. Anyway, the CRT's pulsating energy and pentagrams and (if you'll pardon the pun), all hell's breaking loose. Our boy has superhuman powers bestowed upon him by the necromancing CPU, allowing him to wreak total havok over his enemies, not to mention raising the stock of studio blood producers by a full eight points on the market.

This blatent misrepresentation of the capabilities of a home computer is an incredible scandal, but there is a bright side. The Apple survived the three thousand degree fire that climaxed the film. I wonder if it is the same one that Apple has been using in their ads lately. The cat looks familiar. I wonder if that Latin-to-English database is translatable to the Model III. Hmmmmmmmm. . .

This California sunshine is terrific. We took the Secret agentmobile south to San Diego, to a little shop called Dimensional Software in an outskirts mall.

Dimensional Software is one of the many TRS-80 software/hardware shopping center locations I've visited this year. The interior is clean, well organized into departments, and well stocked with all manner of software from games to business. Two doors from a Radio Shack company store, they exist symbiotically, even though Dimensional Software sells a nationally advertised retrofitted double disk drive TRS-80 Model III.

I found the staff to be knowledgeable, courteous, soft spoken and eager to please. It was refreshing to find a non-Radio Shack computer center that respects the TRS-80 as a factor in the marketplace.

If you're in the Los Angeles or San Diego area, give these guys a try. They've got a dynamite gig going.

Here's the Software Secret Agent, boarding a DC-10 for the return trip to Boston airport. It's ten below zero in New Hampshire, that's twenty degrees too cold for my boot-phone to work outdoors. Oh well, summer's coming.

• • •

She's long, lean and sleek, built for speed and high maneuverability in atmosphere. She carries five, rapid-fire L-230 medium range laser cannons fitted for short burst high energy saturation power. She's a combat pilot's dream come true.

Who is this lovely lady who's stolen the heart of a dyed-in-the-wool Software Secret Agent? She's the planetary fighter ship from Adventure International's new arcade game called Eliminator.

Ordinarily I don't get all that excited about arcade look-alikes. But from the moment Eliminator arrived, I was impressed with its demeanor. Even the exterior packaging is a cut above the norm. The nameless artist who labors endlessly to enhance the front covers of Scott's software has absolutely outdone himself with this one.

The program is a pleasant surprise. The graphics are vastly superior to any currently available offering in this genre. The screen display is very nearly three dimensional and the execution is so flawless that it is difficult to believe that there's not a film running inside the CPU.

The components of the game are basically similar to that of the popular arcade game Defender. There are towers on the ground which move in perspective. The stars in the background add depth of field. The realistically-depicted fighter is bi-directional. Motion is controlled by the arrow keys, and a radical change in horizontal motion produces a Newtonian skidding

motion that can be fatal if miscalculated.

The creepy critters that materialize to battle with the Eliminator are typical space invaders, dixie cups with eyes and lasers, quick-witted and flawlessly deadly. They form from matter pools and attack the player's ship with a ferocity I've not experienced since the shark in Terror at Salachi Bay got heartburn trying to turn me into a cabin cruiser sandwich.

All in all, Eliminator is a winner. Despite its obvious difficulty, Dickie, resident arcadeophile, dispatched the Adventure International high score that comes with the game within six hours of play. Judging from the noises of excitement he and his sidekick, John, were making, this one should be a natural for the peanutbutter and laserpistol crowd. As for myself, I enjoyed playing it. The game entertained me while giving me ideas on how to equip a new Secret Agentmobile. I recommend Eliminator wholeheartedly. It is slick, professional, and, without qualification, a blast.

Sky Warrior, also by Adventure International, shares the talents of the invisible artist. The artwork is stunning. But there, the similarities between it and Eliminator end. Also commercial arcade based, Sky Warrior is a haphazard and amateurish pale imitation of the original. For a company to release an alpha-character-based spaceship shooting little arrows on the heels of a beam-shooting slick silhouette of a sharp fighter is inexcusable.

Taken on its own merit, Sky Warrior holds up. The scenario of moving through the jagged overhanging cliffs, bombarding anti-aircraft bases, does work. It's not too hard to squeeze a good time out of the game as a whole. But the graphics are reminiscent of a Softside type-in, stick-man pop-dot flicker-arrow-go-boom that would have been state of the art at the time of Instant Software's Doodles and Displays package.

Sky Warrior has speed and the reputation of its quarter-a-game counterpart going for it, but let's face reality. The software buying public has played Robot Attack with graphic men and Scarfman with very realistic ghosties. They've played a blue million versions of Space Invaders with as many different creepy crawlie base munchers, and Duel-in-Droids with honest-to-goodness swordfighting Andys. Are they going to pay a premium price for synchronously moving diagonal dots, a spaceship that would have Doctor Smith turning up his nose on a free ride back to Earth, and Harry Mudd giving up grifting?

Yes, very likely—if for no other reason than despite its visual inequities, Sky Warrior is not a ripoff. It's not a boring game, or an easy game, a slow, or even a *bad* game. It's just an *unprofessional* game. That, in and of itself, is not a fatal flaw. Tell you what . . . if you disagree, write me and tell me. I'm not infallible by any stretch of the imagination.

It is not like the early days of software production anymore. Back then (in the Doodles and Displays years), a small producer could put together a Lunar Lander or a Wumpus, get a neighborhood artist to paste a clip art spaceship or (whatever a Wumpus is) on a Xerox sheet, stuff it into a ziplock, buy an inexpensive ad in a small magazine and sell a couple of hundred copies for munchie money. The big guys changed that.

Now, there are a handful of distributors who hold the key to hundreds of small stores who seldom buy from unrepresented independents. And, there are a handful of Big Gun Software companies, the Software Superpowers (like Instant Software and Adventure) who've sunk megabucks into multi-colored ad campaigns and expensive, versi-talented staffers whose jobs are to merchandise to the masses. There's nothing wrong with that. But with that national reputation comes a public trust, a duty, if you will, to be true to the customer.

Underneath the highly polished ultra-slick packaging, beyond the clever wording of the advertising, had better be a solid, top-quality program. After all, $19.95 is too much to pay for a five by seven, five-color piece of artwork with writing on it—even if it IS a limited edition. ■


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# MX-80 mods for Model I

## . . . without an expansion interface

**Model I and MX-80**

Robert L. Green, Atlanta, GA

If you have a Model I with no expansion interface, but want to use the Epson MX-80 printer, this simple modification is for you.

I purchased the MX-80 for the Admissions Office of Dekalb Area Technical School to replace an old RO-33 teletype, but the MX-80 would not handshake through the Radio Shack Printer Interface (cat. no. 1411). I paid hundreds of dollars for a paper weight? A call to Jade (where I bought it) resulted in an engineer telling me he'd never seen it done, but someone had soldered a jumper to make it all work. A local Apple/Epson dealer said it could not be done. A Radio Shack Computer Center said it was not possible . . . so, I had to do it!

Put a towel on a flat surface and lay the printer face down (after disconnecting wire rack, cable, etc.). Use a phillips screwdriver to unscrew the corner screws, but leave them in their respective wells. Tape the holes (to hold the screws). Turn the printer back over and pull off the black plastic roller knob. Carefully pull the printer top up and to the right, being sure to clear the protruding roller stud. If resistance is felt, note the colored wires at the base. Push them down and forward (to you) to release them and slide the printer case top off—not pulling off the wires in the process. Stand the top on its side and slide the back corner of it under the printer base for support. The owner's manual should have covered all of this, before, to let you check out the two blocks of dip switches. (See Diagram A.)

Use a phillips screwdriver to remove the two screws holding down the small 3"x5" printed circuit (PC) board at the left rear. Cut a 3½ inch, small diameter, insulated wire. Bare both ends and coat them with solder. Use a small common screwdriver to carefully pry up the two rectangular black pin connector boxes between the PC boards. Lift up the small PC board to expose the shiny, flat input pins at the rear.

Bend one end of your jumper into a hook and hook it onto the farthest right shiny, flat, input pin connector (Diagram A again). Solder it. Note Diagram B. Solder the free jumper end to the bump of solder found above the lettering: 74LS3673B. The bump is above the main CPU (Diagram B).

Careful folks may wish to test the unit by hooking up the cables, paper, etc., before reassembly, but I did not. Replace the small PC board and carefully push the black pin connector boxes together and screw in the two screws.

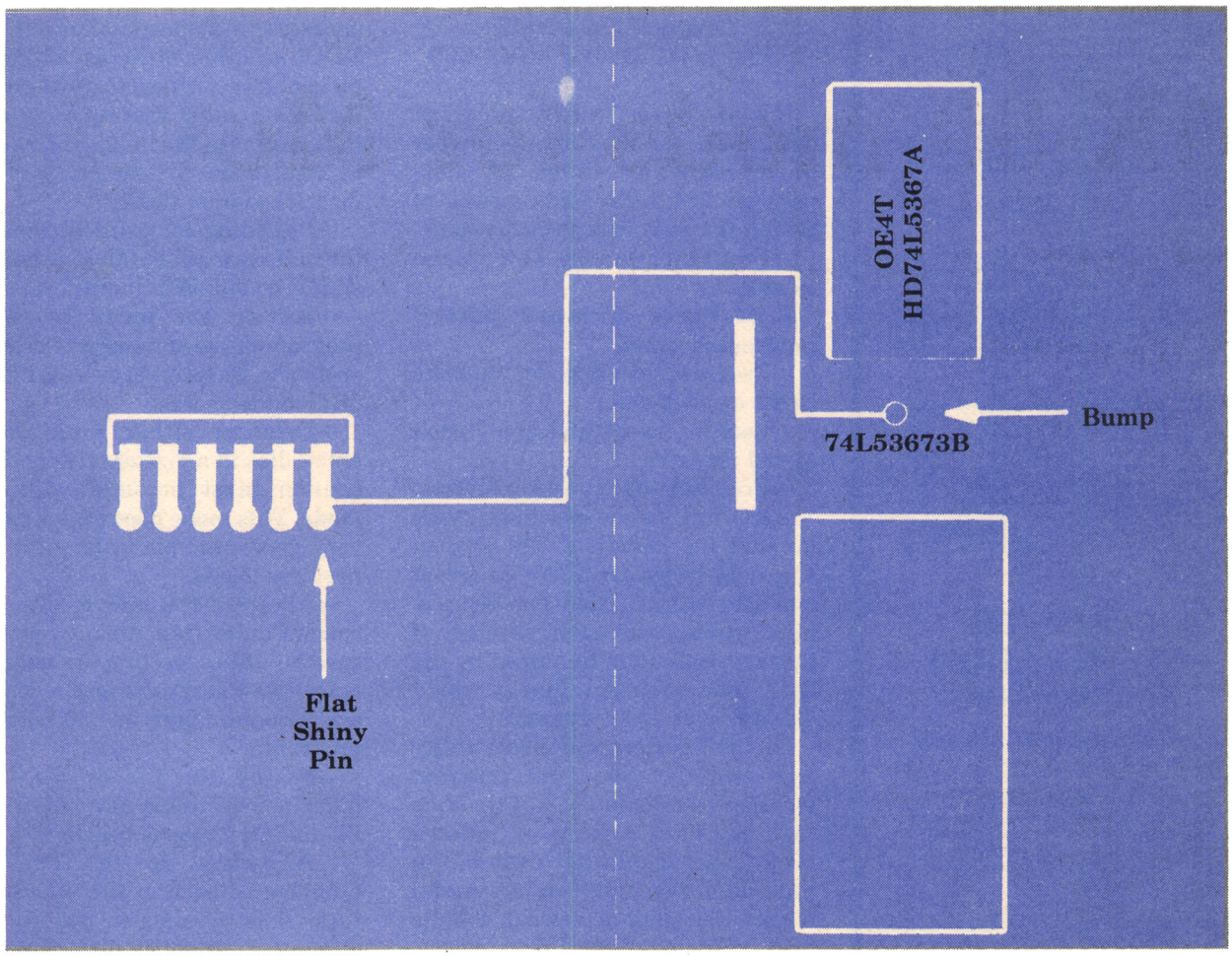
### Option

Epson published a consumer bulletin for printers that encountered registration difficulties. You may want to take your printer in for the free modification (before you use mine) or do it yourself. A local dealer let me exchange the CPU for the three EPROMs kit. I popped out the CPU, following Epson's printed directions, then pushed in the three EPROMs and cut the jumper marked (J1) to the right of the CPU.

Slip the cover back on (watching to get the metal roller rod into the side hole). Replace the roller knob. Turn the unit over, remove the tape on the corners, and screw back the screws. Flip the unit back over and attach the cable and interface with the blue-coded wire to the left of the operator (coming from CPU, black box, and going into the rear of the printer). You now have a fully functioning printer at substantial savings of both dollars and time.

Diagram A

Diagram B




Circle # 48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"**OMNITERM** has my vote as the top TRS-80 terminal program available today" Kilobaud Microcomputing, June 1981, pages 16-19.

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## Reviews

### Discat
### Racet Companies
### 1330 N. Glassell Suite M
### Orange, CA 92667
### Model I/III 32K or 48K—$50

Discat is a utility program designed to aid the computer owner in creating an index of disk-program location records capable of giving the following information:

—Program names and name extensions

—Diskette number where program is stored

—Program location on diskette (front or back side)

—Length (in granules) of each stored program

—Free disk space on each diskette

According to the excellent user's manual for Discat, a 32K system can hold in excess of 800 program location records. There can be up to nine indexes in each catalog of indexes, individually named by the user. The program library could contain over 7200 programs.

In a 48K system, the Discat utility can provode over 1900 program location records in each of the nine indexes. This catalog of indexes could contain data for over 17,000 programs, depending on how many tracks your disk drives can handle and your available disk space. Seventeen thousand program location records could fill over five diskettes with data.

Placing all of the 800 (or 1900) program records in an index in memory at the same time allows extremely fast access to the location of a particular program on disk.

Discat is written in machine code and, according to the user's manual, is capable of:

—Loading an index file containing over 800 records into memory in *less than 15 seconds* (1900 in less than 25 seconds).

—Searching for the location of a specific program in less than three seconds (for an 800 entry file).

—Automatically keeping track of free space available for each of your diskettes.

—Changing the active drive from zero through three for use by systems with more than one disk drive when in the automatic directory update mode.

—Allowing manual program/disk number entries for those special cases such as foreign operating systems (similar to CPM, VDOS or other diskettes without a normal directory system) where the diskette number and contents need to be added to the index and cannot be read from the directory of the diskette automatically.

—Providing for printed copies of the indexes in the catalog, either in a single- or double-column format.

—Sorting the index by either program name or number. Sorts 800 entries in 25 seconds or less, 1900 in 65 seconds or less.

—Deleting either program or entire disk in a matter of seconds, so caution must be used with this mode. This mode does provide some very good prompts to help prevent needless losses.

—Allowing the user to clear the current index from memory using a special utility section in order to start a new index without rebooting and also providing an exit from the program.

—Saving the file to the same index or selecting a new index after file maintenance is finished.

—Allowing up to 100 disk numbers in each of the nine index files. It is possible to use up to a maximum of 9999 different disk numbers. By making up different indexes on other disks it is possible to build a library of programs on numbered disks that could be arranged in ten 1000-diskette catalogs.

Discat is completely menu driven and is therefore easy for anyone to use. It also gives plenty of warnings where errors could be costly.

This review is not intended to describe all that Discat can do, but to give the reader some insight into its potential. At the time we started using it, we had over 1500 programs and had made no attempt to organize them by subject. It took approximately two hours to catalog and the speed at which it finds any given program is fantastic. We chose to make one index of our master's (original copies) which has been extremely useful.

Our only complaint is not a serious one. One of the other programs we used had the

capability of "comment lines" in the hard copy of the catalog. That is not possible in this program, but its loss is more than compensated for by the capacity, speed and ease of use of Discat.

Although we did not test this program with a large variety of operating systems, we did find it to be compatible with most operating systems, including NEWDOS80. It is *not* compatible with double density at this time.

This program is definitely a "must" for anyone with a varied program library.

**John and Nikki Newman**

**TRS-80 Assembly Language**
**by Hubert Howe, Jr.**
**Prentice Hall Books**
**186 pages, hardbound $9.95**

I cut my teeth on Bill Barden's TRS-80 Assembly Language Programming. It is a painless and simplified tour through the wonderland of Z80 programming for TRS-80 users. It has some deficiencies though, such as no mention of ROM calls, disk I/O, or interfacing BASIC and machine code via the USR function. Floating point is mentioned in passing, but not enough to give any decent understanding of the subject. Still, it is a good book.

Hubert Howe's book, TRS-80 Assembly Language Programming, on the other hand, has chapters on all of the above deficiencies. It is clear and very easy reading, although not long enough to be exhaustive.

It starts out, innocuously enough, with a basic introduction to terminology: ROM, RAM, video, binary, hexadecimal, ASCII and number formats. It then goes on to Z80 architecture with an introduction to the registers. One nicety is the explanation of the addressing modes presented in table form; a feature lacking in most other books. Thus, the wayfaring beginner can easily find out which addressing mode is which when he needs to reference a command.

Chapter two and the following one deal with an overview of Z80 instructions. Howe's approach seems a little scattered to my methodical tastes. The approach is taken to avoid panicking the students.

Chapter four discusses the stack: What a stack is, what it does, and the commands we have for it. This includes not only PUSH and POP, but also CALL and RET.

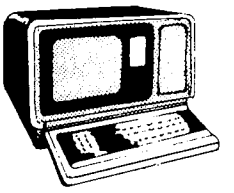
Chapter five has a brief memory map for the TRS-80 and discusses some ROM routines. A nice point about this is that it tells which registers the ROM routines will use. The map is not exhaustive, but it really needn't be. For most assembly language programming, you cannot use many of the ROM routines. Keyboard and video routines are there, and knowing how to use them is helpful. The cassette I/O routines are discussed, as well as some other miscellaneous I/O routines. The entry points for the BASIC reserved words are presented as well.

After this 50-page introduction, which is eminently readable, chapter six begins the programming information. Here we are told how to use the editor/assember. Radio Shack's manual is not as plain to read as some people would like (although it reads like a Superman comic compared with the AIM 65 editor/assembler instructions). This chapter is an account of how it works, complete with a sample program. It makes sense of the manual and when there is no one else around, it's nice to have a clear reference.

The next chapter talks about getting numbers - binary, hex and decimal - in and out of the computer. Back when I first got into this sort of thing, I was concerned about getting my numbers out. What can I do with this fancy program if I cannot get the answer out of the machine? This section is particularly good as an introduction to the video display of numbers, in both hex and decimal. The routines in this chapter cover input as well as output of numbers.

Next, Howe talks about arrays, tables, and other simple data structures, followed by a discussion of the movement of data. A few methods for storing data in tables are given. The movement of data is straightforward and he discusses searching for specific data in blocks of memory.

Chapter ten, Arithmetic Operations with Integers, includes the two's compliment binary representation. This is important, although its utility is more theoretical than practical with the advent of hexadecimal monitors.

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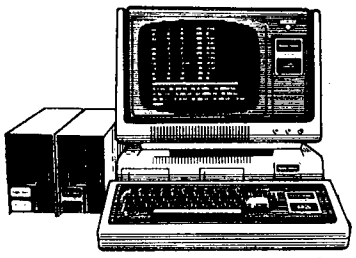

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The various addition and subtraction commands are noted and discussed in a reasonably complete fashion, including multiple precision arithmetic.

Chapter 11 is on floating point numbers and BCD (Binary Coded Decimal). The chapter is a bit short (pun intended) and talks about the basics. It ought to be longer to really deal with the subjects. The format used for TRS-80 floating point is briefly talked about. More information would be nice, but for a beginner, the discussion is well done. BCD is discussed in greater detail. Rightly so, in my opinion, since it is both easy to implement and understand.

Chapter 13 is devoted to multiplication and division. Routines for both eight and 16 bit multiplication are presented here in such a manner as to make some fairly difficult concepts transparent.

The chapter on cassette I/O is excellent. There is even a routine that reads machine language object tapes, gives the name, starting, ending and transfer addresses, complete with comments. Tape formats are discussed. Also here is a routine that will read and store non-standard tape formats in memory where they may be examined. In my opinion, this chapter is much better than any other I have seen on the subject.

The chapter on USR routines is fairly good. It discusses a variety of concerns for the USR-user; such as accessing the routine, returning from the routine, and passing values back and forth. Hybrid programs that sort numbers and strings are presented.

The place where the book shines is the chapter on disk I/O. Few books on assembly language programming even mention the subject. Little known topics such as choosing the drive and writing and reading bytes are discussed. Topics such as reading a sector or track are included and all routines include comments. Excellent!

The last chapter deals with disk files. The directory is discussed along with the different types of file formats. Although much of this information appears in other books, it is nice to have here. The FPDE (File Primary Directory Entries) are mentioned and decoded, and the information is presented in an easy-to-read table. Information on GAT and HIT sectors, passwords, and the math formula used to get the 2-byte HASH codes are all there. This chapter is the best part of the book.

Howe's book is an excellent place to start for someone wishing to learn more about his or her TRS-80. It is not *the* book on assembly language, but is well worth the price.

**Bruce P Douglass**

**Planetoids**
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Planetoids, written by Greg Hassett and marketed by Adventure International, is a high speed, multi-option version of Asteroids. In its basic form, it offers the arcade player the same challenge as does the original Atari arcade version, minus the sound effects and the excellent high resolution graphics. Then again, an Asteroids game machine costs $5000 and eats quarters all day. The graphics in Planetoids are excellent and the lack of sound effects may actually be less distracting to some players.

Placed in the center of an infinite field of asteroids, you must use your ship's laser cannon to destroy as many of the asteroids as you can, avoiding collisions with the obstacles. As you blast the gigantic rocks, the impact of the laser splits them into smaller fragments. Your score depends not only on the number, but also the size of the asteroids that you annihilate. The smaller targets are worth more points than the larger ones.

To make it more interesting, alien spaceships attempt to eliminate you. You can rotate your ship into 12 different positions, use your thrusters, fire your cannon, or attempt hyperspace escape. Hyperspace is used as a last ditch effort to escape enemy fire or collision with an asteroid. You may find that hyperspace relocates your ship in a worse location than where you were (on an asteroid or enemy ship).

There are five different types of enemy spaceships that attack your ship. Most are fairly easy to destroy, the exception being the dreaded Zoron Battle Star. This one fires

multiple, high-speed missiles very accurately. Your only hope is to blast him before he gets a salvo off. This ship is also the only one that is not destroyed by collision with the asteroids. As your score increases, so does the frequency of the appearance of the enemy ships, the number of missiles fired by the alien ships, and the number of asteroids. It becomes increasingly challenging as your points mount. Scores of over 100,000 are uncommon.

What sets this version apart from the rest is that there are eight options that can be activated during the game. The first option freezes the action indefinitely so that you can rest your fingers, answer the telephone, or tend to other trivial matters. Practice mode allows you to play at the higher difficulty levels offered by high scores.

You can abort the game at any time by pressing "2" and no one will ever know. You can save and load the top ten high scores to tape with options "3" and "4". There is a high speed option available that doubles the speed of the asteroids. "Cruze" mode slows the asteroids down to almost a stop, allowing you to practice using the thrusters. "Dogfight" eliminates the asteroids completely so that you can fight the alien ships without worrying about hitting the asteroids. You may also combine dogfight with the practice mode, giving you a real challenge.

This game is probably the all-time favorite around our house. It has all of the features that make for many hours of entertainment. The top ten scores are posted after every game, giving the holders a reward for their skill and bravery. It does not become as time worn as some of the other games available for the TRS-80 and the multitude of extra features give it an edge over competing versions.

**Jim Klaproth**

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Some programs achieve instant notoriety. Others, equally good, don't receive half the attention they deserve. One such program is Invasion Orion, by Automated Simultations. Although it's been out for two years, it's only recently been getting the advertising space that its qualities merit.

Invasion Orion is the solitaire version of Starfleet Orion, a game in which two players maneuvered various types of starships in combat against one another. In Invasion Orion, the computer itself becomes your opponent. While it is by no means as capable as a human opponent, the resulting games are always an interesting challenge. The newest versions of Invasion Orion also allow you to play against a human opponent.

Invasion Orion is available either as a 16K tape, or as 32K disk. Invasion Orion now comes in a box which contains the program tape or disk, and an instruction booklet that's a wonder to behold. The instruction booklet (i.e., the "Battle Manual") practically deserves a review all by itself. Obviously prepared with great care, the operating instructions are clear and explicit. The Battle Manual explains the historical background against which the various scenarios are played.

Briefly, Invasion Orion recounts the struggle of the human Orion colonists against the alien Klaatu invaders. Each scenario consists of a short story that sets up the action, the characters involved, the type of ships on each side, and the positions of the ships and planets in space. All of the variables relating to the ships and planets are changeable—i.e., you can create new scenarios at will. All of the short stories are well written; no mean feat in itself.

As an added bonus, the Battle Manual also contains design notes, notes on tactics, a discussion of the decision, models used by the computer, and a short survey of the specific algorithms involved. Older versions of the game also included complete listings of the programs. All in all, an insightful mix of material that I've read with fascination several times.

The program tape consists of three parts. Side One contains two programs. The first is the Game program, which is used to play the

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various scenarios. The second is the Builder program which is used to create the scenarios and save them. Side Two of the tape contains the data for the first two scenarios.

If you want to play the remaining eight scenarios in the Battle Manual, you have to first create them with the Builder program and then save them on a separate data tape. This is not difficult, and the saved copy can be used over and over again. The disk version has all ten scenarios already prepared and ready to use.

To play the game, you first load the Game program. Then you position your scenario data tape on the recorder. The Game program will request the name of the scenario to be played, the side you wish to play on, and the desired level of experience—i.e., difficulty. You can direct the forces of the Klaatu if you're feeling particularly heartless, and the computer will command the Orion ships. The computer isn't always very good playing the human side. In some scenarios, it's not practical at all, but the Battle Manual is usually quite explicit about this.

The action takes place on an invisible grid 62 units in width and 34 units in height. There is no depth dimension, except that two or more ships may occupy the same location without colliding. The ships appear as lighted bits. Each is identified by either a letter or a number so you won't get confused and shoot at one of your own ships. There are up to nine ships on each side.

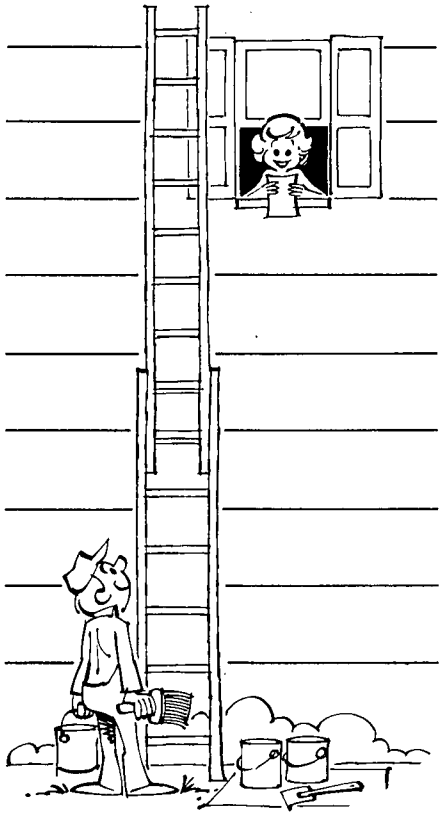
A table at the back of the Battle Manual lists the various types of starships and their characteristics. There are 34 types in all, ranging from fighters to dreadnoughts. The ships differ in many ways, such as drive strength, beam power, number of launch tubes, number of missiles and torpedos, armor thickness, and total energy available. The computer may be queried at any time during the course of the game regarding the current status of any of your ships. It will not reveal the status of its ships until the scenario is completed.

If a ship is hit by a beam, it flickers. Missiles appear on the screen as asterisks; torpedos as blinking bits that move slowly across the screen. If a ship is destroyed, it explodes at the end of the turn in a shower of lighted bits. Several of the scenarios make use of tractor and pressor beams to move ships around.

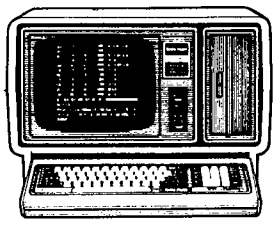
I have played Invasion Orion for several months now, and I have never found it boring. There are some minor problems. Torpedos launched along the boundary of the playing grid take a great deal of time to move along their trajectory. You can only launch one torpedo at a time, no matter how many launch tubes you have available. Scenario names appear to be limited in length to 15 characters, but there is no mention of this in the Battle Manual. If you create a scenario with a name that is too long, it will not be loaded correctly by the game program, and your entire effort will be wasted.

But this is quibbling. Invasion Orion literally lets your imagination run wild. Frustrated science fiction writers take note! If you ever tire of the scenarios given, you can create new ones at any time. This program is a bit more expensive than some, but I feel that the investment is well worth the many hours of enjoyment that it will bring.

**Dan Cataldo**



*"Hey Harold! The program says PRINT@, not PAINT@"*

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We had just returned to Castle Sjaelbjerg after defeating the defense forces of both Castle Jammer and Castle Vakker. The battles were decisive and the victories complete, with no quarter asked and none given. I was pleased to have our leader promote me to Sergeant in our small, but proud, air force. As chief gunner and navigator, I was called before the king's own defense advisor and given the latest map of the known world. He told me then that this map had cost the lives of not less than 20 expeditionary groups and that even though there were several copies, none was complete. Somewhere, in one of the other castles, was a map showing the way to at least two more castles beyond the eight which we know and had mapped.

My job was to obtain that information. Success meant promotion, fame, and wealth; defeat would only offer death as its reward. Refueling completed, we lifted off and headed south from our home.

Almost immediately, we were intercepted by a squadron of the infamous Fugloy air force. We were able to kill only one or two of them. We managed to hide above in the clouds before our energy reserves were depleted to the point that our defense shields would have failed. We continued on to our first destination—Castle Torden, each of us wondering if we would be the next crew to disappear in our long search for the mysterious missing lands and their reported riches.

With just a little imagination, Leo Christopherson's latest master-piece, "Voyage of the Valkyrie," can be as adventuresome as any other game currently available to TRS-80 users. The basic object of the game is to find and conquer all 10 castles in the imaginary land of Fugloy. Each castle is defended by a group of ruthless birds whose primary pleasure in life seems to be to deprive you of your own precious life. Before you can do battle you first must find them, and this is the first stage of the game.

The game package on diskette comes with 11 pages of instructions. After reading and digesting the rules of the game, you are ready to begin mapping the land of Fugloy. You are also provided with about 10 maps of the game board you will be playing on. Your starting position is marked, but that is about all that is marked.

The mountains you may run into aren't marked. Neither are any of the fog banks (all the castles are located on islands). It is up to you to determine which paths are safe to fly and which are roads to destruction. Once you have a completed map, you may begin a campaign of conquest, although by this time, you have probably been smashed against seen and unseen mountains, lost at sea, or shot down by the Fugloy air force.

The first thing you notice about this time is that you only have a map of eight enemy castles, not the ten

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promised by your manual. Despair not, you will have an opportunity to locate the last two once you have captured the first eight. Yes, more mapping expeditions are yet to come. That is the last hint I will give away.

As we have come to expect from 037's past efforts, the animated graphics are superb. The birds of each castle are depicted both flapping their wings to climb for altitude and with wings extended as they soar down toward you. As many as six or eight of them may appear on your display before you kill them all off. Each one will dodge your fire and getting them into the moveable cross-hairs on your weapon system can be a really tough job. That comment leads me to my only real complaint about the game: the fire control and aiming system.

The sights consist of a vertical and horizontal line of dashes that can be controlled separately or as a pair with the buttons of the number pad, or just the number keys if you do not have a number pad. This presents somewhat of a problem in trying to watch the screen and remember where your fingers are. You *must* watch the screen or you will surely be killed. Practice has helped me over this problem. Joysticks would have been nice, but no mention is made of the program supporting any joysticks, and I don't have any to try out (got to get one, just as soon as Someday shows up on my calendar).

Mr. Christopherson is probably best known for his animated graphics used in combination with well developed musical effects. He hasn't neglected the audio aspect of this game at all. There are respectable sound effects during the action portions of the game, and he also gives you the option of having selected classical pieces played during the breaks in the action. The option is given so that those without sound capability would not have to sit and stare at an unmoving screen while some of Richard Wagner's operas are played.

If you hook up your external amplifier speaker and respond "Y" to the question "Sound?", you will be greeted with the March from Tannhauser as you begin a game. "The Ride of the Valkyrie" is played each time you capture a castle. If you are killed during the game, another selection from "The Valkyrie" is played at your funeral. I will let my wife testify to the quality of the musical selections. When I first fired up the game disk and it began playing the march through my Radio Shack telephone listener, she came back to the computer room saying, " I *know* you don't have an organ back here." I think that speaks well enough for the music. A demonstration at the Midwest City Radio Shack Computer Center brought the comment that it was probably as close to two voices as you could get with the setup.

There are ten levels of difficulty to choose from. The differences lie in the number of birds that will be defending each of the castles. More birds mean more trips between your home base for refueling before any given castle can be defeated. This results in a longer game and a greater possibility that you will run out of power during a battle, or out of fuel when trying to return to base. Either condition is, of course, fatal.

During play, the only "fault" that I noticed was that my rate of fire decreased as the number of attacking birds increased. This is not really noticed until you are

under attack by four or more birds and does not detract much, if any, from the game.

The packaging is nice. The diskette has booted without problem each time (although I am using a backup created with Super Utility Plus). The instruction manual is of good quality and the instructions cover the theme, objectives, and rules of the game completely. The disk is usable on both the Model I and the Model III computers. Model III users must first CONVERT the diskette files to a TRSDOS 2.2 diskette. Instructions for this are in the manual as are instructions for those who purchased the cassette version.

I would recommend this game as a MUST to have in any library. It requires the player to have the strategy planning ability of Risk, the digital dexterity of a piano virtuoso, and the patience of the sphinx. The rewards are hours of challenge, frustration, and a full color poster from the distributors when you find all ten castles. This is not a game you will master at one or two sittings—and those sittings will probably be hours long. It is addictive . . . and GREAT.

**Jerry L. Latham**


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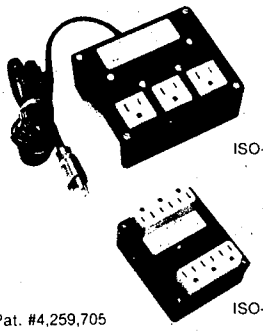


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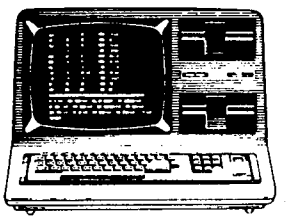

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## Reviews

**Olympic Decathalon**
**Model I, 32K Disk $29.95**
**Microsoft, Inc.**
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**(206) 454-1315**

Olympic Decathalon, by Timothy Smith of Microsoft, has to be one of the all-time greats in the TRS-80 lineup of gaming software. More than just a simple game, it is a cleverly designed simulation of the Decathalon, the ultimate test for an athlete.

The program is available on either disk or cassette, but only the disk version was tested. The package consists of one diskette and a 48-page instruction manual. The diskette may be backed up once. It is then rendered uncopiable by normal means. A replacement diskette may be obtained for $7.50 from Microsoft. After backing up the original, the disk is booted and then a spectacular graphics display dazzles the user.

Each event is presented in order, with one or two athletes competing at the same time. The computer puts contestants in random order so that if more than two are competing, the same two contestants do not compete against each other in all of the events. The first event is the 100-meter dash. The screen displays an oval track, complete with start and finish lines. The runners are depicted with two black squares on the white track. The starting gun is displayed, and when the "go" flag appears, the runners dash toward the finish line as the elapsed time indicators keep track of each runner. False starts are disallowed and will start the race over. After each event is over, the standings are displayed.

The next event is the long jump, which is displayed as a runner on a white line at the bottom of the screen with a small break that represents the take-off line. It takes much coordination to control the jump and keep from committing a foot fault or a face fault.

The shot put is cleverly displayed with the upper torso of a man and his arm. The up-arrow and left-arrow keys are pressed in unison to propel the shot upward and outward. It is difficult to score well in this event and split second timing is involved.

The high jump is similar to the long jump, except that a crossbar is displayed in front of a foam rubber landing pit. The contestant attempts higher and higher jumps until all players are eliminated. This one takes good coordination and timing also.

The 400-meter dash is similar to the 100-meter dash, only one complete lap is run. It becomes fatiguing for the fingers, just as it does for legs in the real thing.

The 110-meter hurdles is my favorite event. A single runner is displayed on a flat track with one meter markings. The hurdles are at various distances. The runner is very life-like and the animation is excellent. This event takes good timing to prevent knocking down the hurdles.

The discus throw is one of the most difficult to master, exceeded only by the pole vault. The discus must be released at precisely the right time in order to keep it in bounds. High scores come only with hours of practice.

The pole vault requires more skill than any other event, both in the real world and in this simulation. Each contestant must make a running approach with the arrow keys, plant the pole in the small vault box, raising to a handstand on the pole, and then releasing at the apex of the vault to clear the bar and land in the foam landing area.

The final events are the javelin throw and the 1500-meter run. The javelin thrower runs up at a constant speed to the arc line, tilting the javelin as he approaches the line. The javelin must be released before the runner crosses the line and at the proper angle to get good distance. This event takes a lot of practice to get good scores.

In the 1500-meter run, two runners compete on the oval track again. This time, the runners are controlled by pressing four keys that control up, down, right and left. It is a little tricky to round the far curves using this system, as two keys must be pressed simultaneously. Sometimes, the runner gets stuck on the track because the player presses the wrong key. At least your fingers don't get tired from "running" as in the other running events.

Olympic Decathalon is a lot of fun to play, as well as being entertaining and educational. My keyboard gets a real workout from all of the athletes around the house. Tim Smith deserves a lot of credit for this magnificent creation. This is the type of program that really shows off the capabilities of our wonderful little micro machines.

**Jim Klaproth**

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After playing several million games in which I had to attack alien monsters, I was getting tired of doing all of the killing. I wanted to be the monster for a change! Well, along came Epyx to the rescue! Finally, a company has created a game that will allow me to do a little ravaging of my own, and permit me to be the monster against all of the other "good guys". this game, perhaps a revolutionary one, is called "Crush, Crumble and Chomp", appropriately enough, since those three verbs are what this exciting game centers around.

One of the major differences in this game besides the reversal of roles, is that it is written almost entirely in BASIC. That came as sort of a shock to me since most "professionally made" games I had ever seen were in machine language. Crush, Crumble and Chomp is not a real time arcade game, so BASIC is allowed. However, this makes for some rather slow action on the computer's part. Plan to spend a lot of time if you want to successfully finish this game.

After loading in the game, setting the memory size to 31166 and using the CLOAD statement, I was ready to go. I entered the command RUN, and the title page appeared. Following that, an option list came up on the

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screen. In the option list, I could choose from six different monsters, five objectives and four cities. With all of these options, there are over 100 different games within one program! I believe that this feature, along with many others, help make up a well-balanced simulation.

There are five different objectives to the game. The first is known as "balanced". In this objective, I can score for anything I destroy. Following this is the "killer monster", in which a few points may be obtained by destroying buildings, and a great deal of points for killing humans. (This game can get rather violent.) The third one of the list is "combat machine." That gives a few points for smashing things and a great deal for destroying the army (in case the monster is anti-draft!). "Destruction" mode gives a large number of points for destroying bridges and buildings, and relatively fewer points for humans. Last, there is "survival" mode, which is probably the most basic—stay alive. The longer the monster survives, the more points are scored.

I was particularly impressed by the option of chosing a city. The four given are New York City, Golden Gate (San Francisco area), Washington D.C., and Tokyo. All of these have different areas, and all four maps are included in the very complete documentation.

After completing these three decisions, I press the ENTER key, and the data begins to load in. Once this is complete, the game begins. I always make sure that my amplifier is hooked up, because there is sound in this game. Though it's not the best I've ever heard, it still adds a lot to the game and should not be ignored.

The screen fills up quickly with a variety of graphics and text. Filling up most of the screen is a section of land and water (depending on the city I am in). Of course, the area displayed is not the entire city, but only a small section of it. The maps show the starting point of land and amphibious creatures, so that I know where to begin my path of terror and destruction.

Of course, there is a wide variation with each of the monsters as to how much potential I have to destroy, and what commands I can use to destroy. However, some of the more common possibilities are to (C)rumble, (B)reath fire, and (O)bliterate. Some of the more specialized commands for different monsters include (U)ltrasonic scream, (T)ail, (P)aralyze, and (F)ly. While playing the game, I may hit the number sign (#) at any time to check my current score, and may continue playing until I am destroyed or starve.

I would recommend Crush, Crumble and Chomp to any owner of a Model I or III cassette or disk system who enjoys simulations, or is just sick of being the good guy However, to the arcade game lover, this program is not for you. It's a little too slow, and doesn't quite offer the action of, say, Galaxian or Alien Defense. Therefore, my recommendation is restricted, but my respect for the program and the programmer is high. The program is very well done, the graphics (for all they are worth) are utilized, and the documentation is hilarious, but informative and complete. Perhaps Wang Lew and I could start a movie.

**Tim Knight**

# Tandy topics

Ed Juge, Director, Computer Merchandising, Tandy Corp.
1500 One Tandy Center, Fort Worth, TX 76102

You've heard me discuss many times, the fact that we can't repair modified TRS-80s. We reserve the right to void your warranty if a unit has been opened or modified. We can't be responsible for non-Radio Shack parts installed, etc. Officially, our policies have been pretty much as stated.

Unofficially, we've allowed our service center personnel to determine when special cases warranted special handling. We ended up with some inconsistencies, though, where one repair facility would agree to work on a unit after another facility had refused. The good news is that we think we've learned quite a bit about what we can do effectively, and what we can't.

About the first of March, a letter went out to all of our service centers, giving them specific guidelines on what to do with TRS-80s which aren't completely "stock". Since it will undoubtedly make a lot of you very happy (and since I think it shows a real effort on the part of our support operations management to increase our level of service), I'd like to tell you about these guidelines.

Up front, let me say that there are some "maximum parts/labor charges" for certain completely stock equipment. Those charges will not apply to units which are "non-stock" in any way. With that caveat, we'll proceed.

First of all, let's look at the case of RAM chips. Those of you with "stock" TRS-80s containing Radio Shack chips: we will replace only the defective chips we find, not a whole set. If you've installed "foreign" RAMs, and we find one or more of them defective, the service center is still required to replace a complete set or none. They will, however, call and give you the option of doing it yourself or having us do it. There will be a checkout fee charged for our time, even though no service is performed.

### Foreign Disk Drives

We have said many times that we can't work on Model IIIs which contain non-Radio Shack drives. Well, our folks tell us that they will accept such units for service . . . partly! This means that if the drives work properly, we will simply overlook them. If the drives are at fault, we will disconnect them, check or repair the "stock TRS-80" portion of your computer, and let you handle any drive problem with the vendor or the dealer who installed them.

I still issue a strong warning to the non-technical reader. This leaves you in the dangerous position I've described before, that Radio Shack will guarantee the operation of our equipment, as the drive vendor may guarantee his drives. But, you'd better be sure someone guarantees that they will work together, unless you have the knowledge and equipment to do it yourself. Now for my sales pitch. A few freight bills or "figure it out as we go" repair bills by a third party can more than eat up your savings.

### Modifications

This one's a bit harder. If a modification doesn't appear to be hurting anything, we'll disregard it. If we can't properly check out the unit, or if the modification seems to be causing the problem, we'll ask your permission to remove it. If you decline, you'll pay only the checkout fee. Otherwise, we'll remove it, return the parts to you, and effect repairs.

There is one big "gotcha". When there are "cuts and jumpers", or damage to the board such that our repair people back here in Fort Worth won't accept it for re-building on an exchange basis. If your computer qualifies, then your only option may be to repair it yourself, or authorize us to install new circuit boards on a non-exchange price basis.

Our repair people will always return any non-Radio Shack parts, whether you request them or not. We've always done this if you requested it when you brought the unit to us, but some of you asked only when you picked your computer up . . . after the parts had been thrown out or mixed up with other defectives to the point that they could not be identified.

There are a couple of other clauses in the new policy that you should be aware of. If our people feel that the computer poses any kind of safety hazard to the service technician, they may refuse to service it at all. Our after-service warranty will specifically exclude the operation of any non-Radio Shack parts or modifications which we leave installed. Also, TRS-80 equipment containing non-Radio Shack parts or modifications cannot be covered by our maintenance agreements.

Having opened, modified, or installed your own parts, no longer automatically excludes Radio Shack service on your TRS-80. It can, however, cause that service to cost you more. A trip to our repair center will not necessarily assure a working computer if your non-stock parts are faulty. See you in June. ■

# High-res graphics for the Color Computer

## *Generate alphanumeric characters in high-resolution mode*

Richard Tangeman, Arkansas State University, AR

### Color Computer

The high-resolution graphics capabilities of Radio Shack's Color Computer are impressive when compared with other machines in its price range. One problem in applying this power is that it is not possible to mix high-res graphics and ordinary text on the same screen. We present here a short, easy-to-use subroutine, written in BASIC, which allows the display of commonly used characters on the graphics screen in PMODE 4. To see which characters are available, see Figure 1 or execute:

FOR I=32 TO 95:PRINT CHR$(I);:NEXT I from the direct mode.

Any string built from the available characters may be displayed starting at any point on the graphics screen. To set up the subroutine array, execute GOSUB 915 at the beginning of your main program. When a string is to be displayed, load it into A$, set the horizontal and vertical tab values HT and VT, and execute GOSUB 800. HT should be an integer value 0-39, and VT an integer value 0-15, where columns are numbered left to right and rows numbered top to bottom. The subroutine does not check to see whether these values are in range. The values of HT and VT are, however, saved by the subroutine in order to allow the use of these variables as loop counters in the calling routine. Thus, the code:

A$="?":FOR HT=0 TO 39: FOR VT=0 TO 15:GOSUB 800: NEXT:NEXT

may be used to fill the screen with question marks, column by column. (Warning: This will take about 20 minutes!)

The characters are built in the usual 5 x 7 dot matrix and stored, one byte per row, in the string array A$(). To see how this is accomplished, consider the question mark, CHR$(63).

In each row, the five available dots are numbered zero to four from left to right. In the top row, we want bits one and two to be turned on, and $2\uparrow 1 + 2\uparrow 2 = 6$. in order to avoid using control characters for row storage, we add 64 to this, obtaining 70, and store the first row as "F", which is CHR$(70). In the next row, bits zero and three are to be set, so we use CHR$ $(64 + 2\uparrow 0 + 2\uparrow 3)$ ="I". Continuing in this manner, we get "FIHDD@D". This resides in A$(31) and in general, A$(K) holds the coded rows of CHR$(K+32) as K ranges from zero to 63.

With an understanding of this technique, the character set may be redesigned as desired, or extended to include, for example, the lowercase alphabetic characters.

It is also possible to use this routine to display rough-but-readable strings in the lower-resolution graphics modes. To see the effects of this, replace line 20 in the listing with: 20 PMODE 3,1.

Although a few characters are rather badly botched, most strings (particularly those involving only alphanumeric characters) are still easy to read.

PMODES 2, 1 and even zero, may also be used, with character quality declining as expected.

**Figure 1**
**A screen dump of the characters generated with this program.**

```
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
```

**Program Listing**
**High-Res Graphics on the Color Computer**

*Note: The underscore character in the DATA statements of this listing must be replaced with a left arrow (obtained with SHIFT-UP ARROW on the Color Computer). The right open bracket is obtained using the SHIFT DOWN-ARROW and the backslash is obtained using the SHIFT-CLEAR keys. With these conventions, you should have no trouble entering the correct code in the DATA statements. —Ed.*

```
10 GOSUB 915:REM LOAD CHARACTER ARRAY
20 PMODE 4,1
30 PCLS
40 SCREEN 1,0
50 HT=6:VT=3
60 A$="AVAILABLE CHARACTERS:"
70 GOSUB 800
```

```
75 HT=Ø:VT=6:A$=""
8Ø FORI=32TO95:A$=A$+CHR$(I):NEXT
9Ø GOSUB 8ØØ
1ØØ GOTO 1ØØ
8ØØ SH=HT:SV=VT:REM SAVE TAB VALUES
8Ø5 FOR N=1 TO LEN(A$)
81Ø I=8*HT:J=12*VT
815 SP$=MID$(A$,N,1)
82Ø REM SP$ IS THE CHARACTER WE   WILL
PRINT
825 GOSUB895:REM GET THE DATA FROM A$(#
) INTO U$
83Ø REM U$ IS A STRING OF 7 BYTES
835 FOR JC=Ø TO 6:REM 7 ROWS
84Ø T$=MID$(U$,JC+1,1)
845 GOSUB 91Ø:REM SET THE PROPER BITS I
N KC
85Ø FOR IC=Ø TO 4:REM 5 BITS     EACH RO
W
855 IF ((KC)AND(2^IC))>ØTHENPSET(I+IC,J
+JC)
86Ø REM ^^ DRAW THE CHARACTER  ^
865 NEXT IC:NEXT JC
87Ø HT=HT+1:IF HT=32 THEN HT=Ø: VT=VT+1
875 NEXT N
88Ø HT=SH:VT=SV:REM RESTORE TAB VALUES
885 RETURN
89Ø REM SUBROUTINE TO SELECT THE PROPER
 ELEMENT OF A$(#)
895 T=ASC(SP$)
9ØØ U$=A$(T-32):RETURN
9Ø5 REM SUBROUTINE TO DECODE THE ARRAY
A$(#) INTO BINARY
91Ø KC=ASC(T$)-64:RETURN
915 DIM A$(63)
92Ø REM A$(I) IS THE BINARY CODE FOR CH
R$(32+I)
925 DATA@@@@@@@,DDDDD@D,[[@@@@@,JJ_J_JJ
,J_A_P_J,SSHDBYY,FIEBMIV,DD@@@@@,DBAAAB
D,DHPPPHD
93Ø DATA@DN_ND@,@DD_DD@,@@@@HHD,@@@_@@@
,@@@@@XX,PPHDBAA,NQYUSQN,DFDDDDN,NQPNAA
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,QQQQUYQ,QQJDJQQ,QQJDDDD,_PHDBA_
955 DATAFBBBBBF,AABDHPP,LHHHHHL,DNUDDDD
,@DBOBD@
96Ø FORI=ØTO63:READA$(I):NEXT
965 RETURN
```

■


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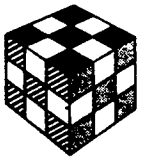

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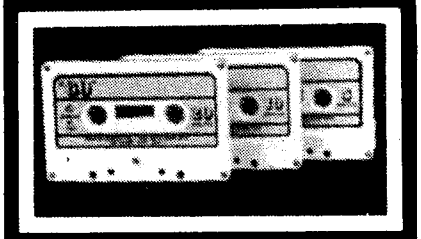

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# Notes

Here are some short tips which will help you to understand the mechanics of converting HEX numbers to their decimal equivalent.

**Remember that in HEX:**
A = 10
B = 11
C = 12
D = 13
E = 14
F = 15

Whenever you see a HEX number and need to convert it to decimal, don't panic. Just simply invert the number and follow the format described below. You should have no trouble determining the equivalent decimal number. Assume you have a number like FF01H where the H signifies that this number is in hexidecimal.

| HEX Number | Multiply By | To Obtain |
|---|---|---|
| 1 ..... | 1 | ..... 1 x 1 = 1 |
| 0 ..... | 16 | ..... 0 x 16 = 0 |
| F ..... | 256 | .....15 x 256 = 3840 |
| F ..... | 4096 | .....15 x 4096 = 61440 |

As a final step, add all of the decimal numbers to the right of the equal sign in the third column to obtain:

```
    1
    0
 3840
+61440
-------
 65281
```

Therefore, FF01 HEX is equivalent to 65281 decimal. If you have a HEX number with only three digits, say F01H, then there simply won't be a number to be multiplied by 4096.

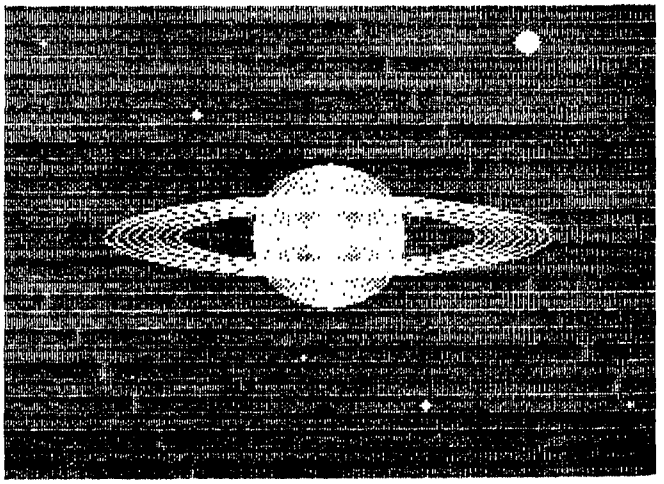
Likewise, for a two-digit HEX number. Here, the last two digits will be missing and so there won't be multipliers. The first digit will be multiplied by one (1) and the second digit will be multiplied by 16. Add up the resulting numbers and the result will be the decimal equivalent.

This method will apply for all HEX numbers whether you have a Model I, Model II, Model III, or Color Computer.

---

Ronel Elul, of Beverly Hills, California, sent us this "one-liner" which does most of what James William's machine language program does in the February 1982 issue:

```
10 REM DEPRESS PLAY AND RECORD KEYS ON RECORDER, DISCONNECT REMOTE PLUG
20 REM FOR DISK SYSTEMS ONLY: CMD"T"
30 OUT255,0:I=0:I=INP(255):IFI=255THENFORX=1TO30:NEXTX:
     GOTO30ELSEGOTO40
40 REM MAIN PROGRAM
```



**Saturn**

This short program will reproduce a picture of Saturn as shown above. The picture is a screen dump to a Line Printer VII using the screen dump software driver provided by Radio Shack. If your Color Computer contains the new ROM (version 1.1) you won't need the software driver.

**Don Scarberry, Editor**

```
1000 PMODE4,1:PCLS:FORZ=1TO30:CIRCLE(12
  8,100),Z:NEXTZ:FORZ=60TO90STEP4:CIRCL
  E(128,100),Z,,.2:NEXTZ:FORZ=1TO2:CIRC
  LE(90,30),Z:NEXTZ:FORZ=1TO2:CIRCLE(18
  0,150),Z:NEXTZ:CIRCLE(240,180),1:CIRC
  LE(10,30),1:CIRCLE(138,50),1
1010 FORZ=1TO5:CIRCLE(50,180),Z:NEXTZ
1020 SCREEN1,0
1030 GOTO 1030
```

Model III owners might have trouble using the FORMS command on the disk systems. The FORMS command will allow you to set the number of characters per printed line and the number of lines per page. The problem is that this command seems to add two additional characters to each line. If you select a 60 character line, the actual printed line will contain 62 characters. Radio Shack tells us they are currently working on a fix.

With the 16K Extended BASIC Color Computer you cannot type in a line containing 256 characters. Here is a way to get a few more characters: When you have typed the 249th character in a line, press the ENTER key. Type EDIT (*line number*). Press X (ENTER). You should now be at the end of the line and will be able to enter up to three more characters for a total of 252.

This procedure is known to work on a 16K Extended BASIC Color Computer with the original 1.0 ROM. We would like to hear from anyone who has this problem on other versions of the Color Computer. ■

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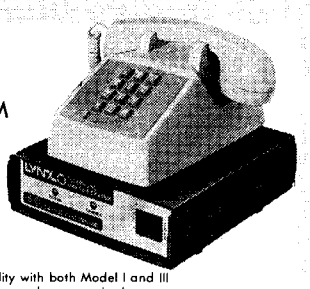

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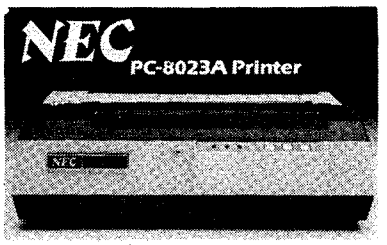


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**FOR SALE: Radio Shack Line Printer VI.** Printer with Model III cable, 30 hours' use, otherwise like new. $600 plus shipping or best offer. Ron Worthington, 2459-1E Prairie St., Evanston, IL 60201, (312) 866-6325 or 982-7863.

**MDX-2 EXPANSION INTERFACE for Model I.** Assembled, includes parallel printer port, 32K RAM, serial port, modem, on-board power supply. Over $240 invested, asking $100 firm. D. Youngs, 3481 Peach Tree Way, Oceanside, CA 92054, (714) 433-9360.

**TRS-80 MODEL I HARDWARE/SOFTWARE.** Various items for sale such as Model I disk drives and various software packages used for Model I before I bought a Model III and sold the Model I. If interested, please write for list: Richard Yehle, 8952 Autumnwood Drive, Sacramento, CA 95826.

**I AM INTERESTED IN TRADING** my non-copyrighted software for your non-copyrighted software. If you are interested, send a S.A.S.E. for a complete list of available software. Charles A. Quante, 1804 S. 19th St., Tacoma, WA 98405.

**WE ARE LOOKING FOR A GOOD CLEAN** backup Model I system for our business Model I now in use. Will buy un-tampered Model I keyboard (prefer 16K), Model I Interface (prefer 32K), Model I Video, Model I Disk Drives (Radio Shack only, single density), etc. Crown Decal & Display, 1608 Edgemont, Bristol, TN 37620.

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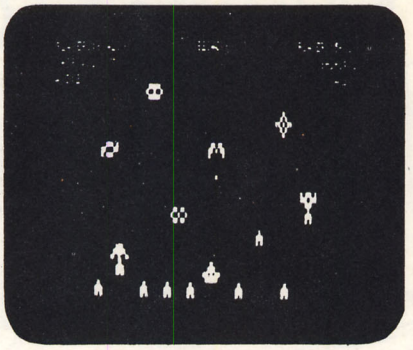

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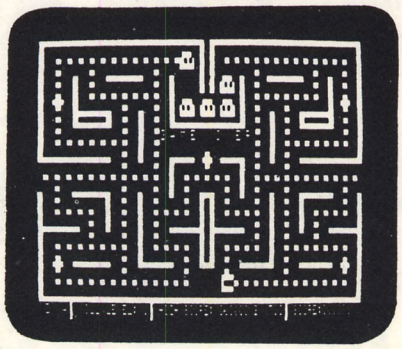

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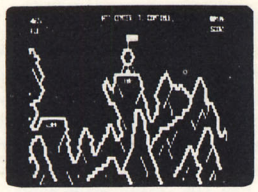

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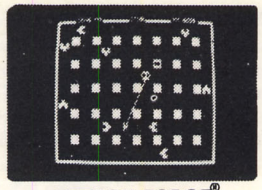

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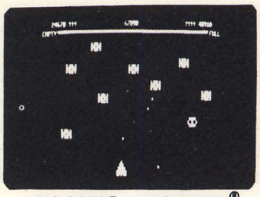

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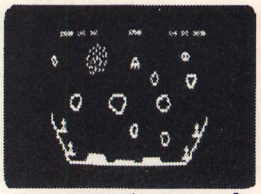

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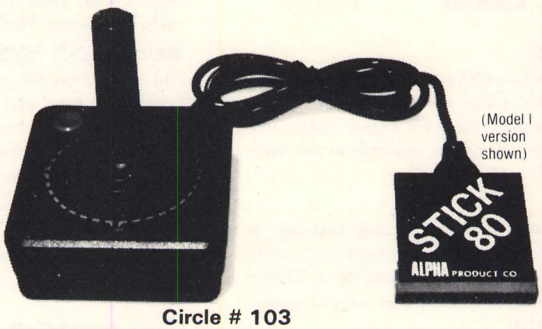


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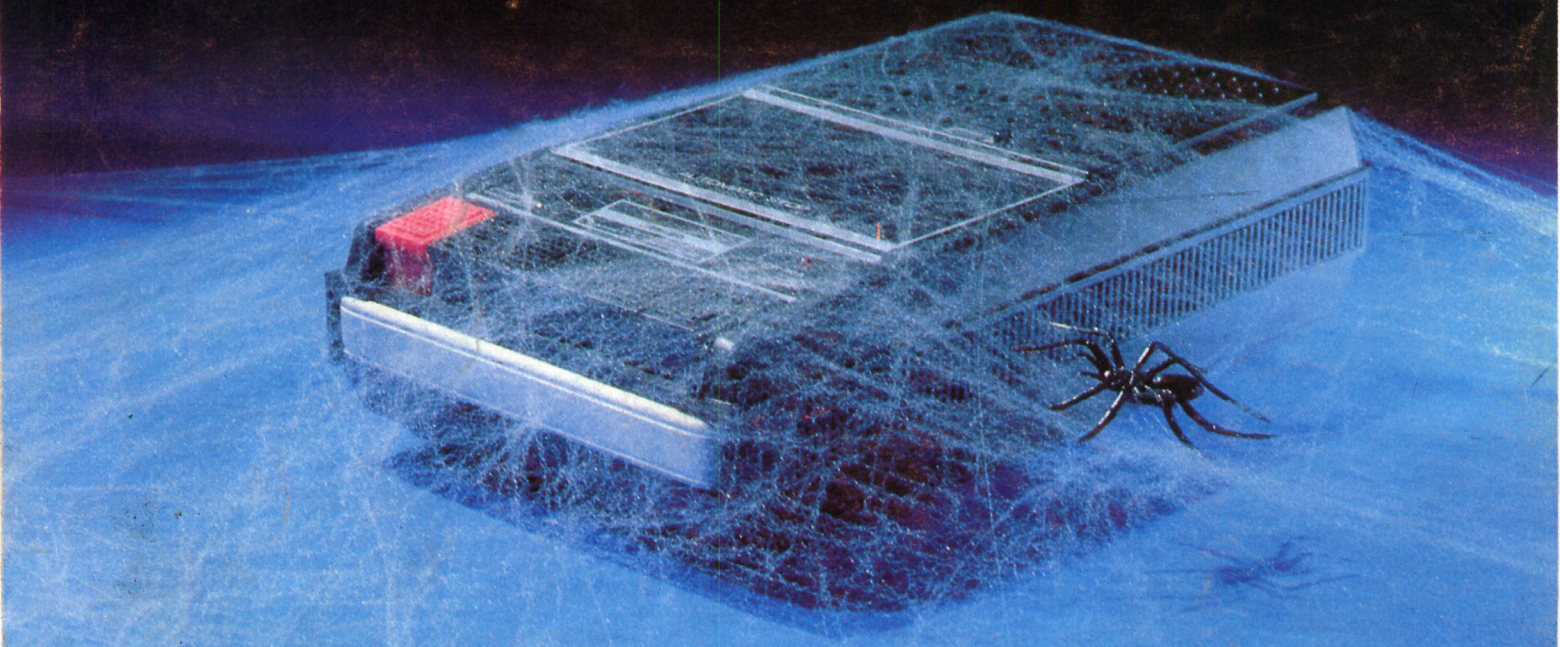

Frustrating isn't it! No matter how much you speed up your program it still seems to take forever to save data onto a cassette. Wouldn't it be great if someone could design a mass storage system with the speed of a disk, but at half the cost? *Exatron* did, the *Exatron Stringy Floppy (ESF)* .

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